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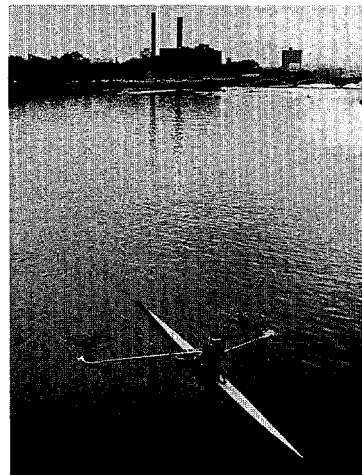
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Report of the Southeastern New England Study



a Strategy for Balanced Development
and Protection of Water and Related
Land Resources in Eastern
Massachusetts and Rhode Island

2. BOSTON METROPOLITAN PLANNING AREA REPORT

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New England River Basins Comm

The Southeastern New England Study (SENE) is a "level B water and related land resources study." It was conducted under the provisions of the federal Water Resources Planning Act of 1965. The resources management program the Study produced was developed by a team of federal, state, and regional officials, local citizens, and the scientific community, under the overall coordination of the New England River Basins Commission. It is a part of the Commission's comprehensive, coordinated joint plan for the water and related land resources of New England.

The recommended program for managing the resources of Southeastern New England is described, in increasing level of detail, in the following Final Reports:

A SUMMARY highlighting the principal findings and recommendations of the Study, and their implications for the future of the region.

A REGIONAL REPORT and Environmental Impact Statement describing *in detail* the natural resources, issues and problems facing the region, the alternative solutions examined during the Study, the recommendations made, and their implications. It includes policies and programs for dealing with water supply, land use, water quality, outdoor recreation, marine resources, flood and erosion protection, and key facilities siting, and the changes in state and local government required to implement the program.

Ten PLANNING AREA REPORTS dealing with the same subjects as the Regional Report, but aimed at the local level. Eastern Massachusetts and Rhode Island were divided into ten "planning areas" based either on traditional sub-state divisions or principal river basins. Reports were prepared for the following areas:

1. Ipswich-North Shore,
2. Boston Metropolitan,
3. South Shore,
4. Cape Cod and the Islands,
5. Buzzards Bay,
6. Taunton,
7. Blackstone and Vicinity,
8. Pawtuxet,
9. Narragansett Bay and Block Island,
10. Pawcatuck

Other reports prepared during the course of the Study include the following:

Inventory Reports

For each of the ten planning areas, inventory reports were prepared covering the following subjects: climate, meteorology, hydrology, geology; land use, patterns, allocations, and management; special environmental factors; water supply; ground water management; water quality control; outdoor recreation; fish and wildlife; navigation; flood plain zoning and streamflow management; inland wetlands management; coastal resources; irrigation and drainage; sediment and erosion; power; minerals.

Special Reports

In addition to inventory reports, over a dozen special reports were prepared, including: Socio-Economic and Environmental Base Study, Volumes I and II; Economic analyses of water supply and demand issues, power plant siting, coastal resources allocation, and sand and gravel mining; Legal and institutional analyses of the state wetlands laws, arrangements for water supply service, fiscal policy and land control, access to natural resources areas, and management structure for water and land use issues; Urban Waters Special Study; Summaries of public workshops

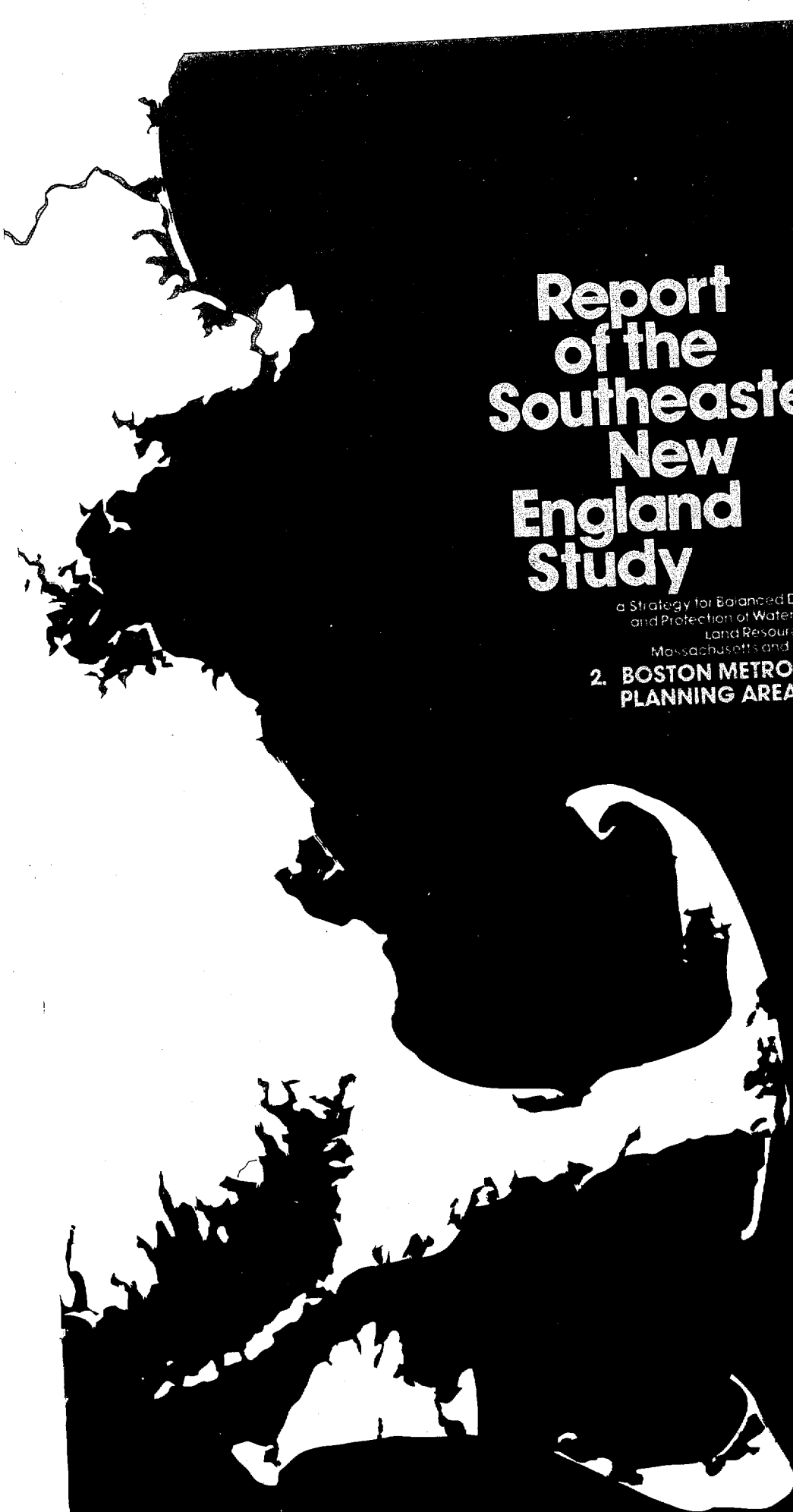
Copies of reports are available from:

New England River Basins Commission
55 Court Street
Boston, Massachusetts 02108

National Technical Information
Service
Springfield, Virginia 22151

and also in each of the 208 libraries and 210 town halls throughout the SENE region.





Report of the Southeastern New England Study

a Strategy for Balanced Development
and Protection of Water and Related
Land Resources in Eastern
Massachusetts and Rhode Island

2. BOSTON METROPOLITAN PLANNING AREA REPORT

New England River Basins Commission
October 1970

SUMMARY REGIONAL REPORT
With Environmental Statement and
40 PLANNING AREA REPORTS

REPORT OF THE SOUTHEASTERN NEW ENGLAND STUDY

READER'S GUIDE: HOW TO REVIEW THIS REPORT

- In five minutes

FOR A "THUMBNAIL SKETCH"

Read the **OVERVIEW** which folds out as one large sheet. There is an extra copy in the pocket in the rear for those who would like to mount it on the wall.

- In a half hour or less

TO LEARN THE MAIN POINTS

Read the **SUMMARY**. It is published separately. You can read it in either of two ways:

- **SELECTIVELY**. Read the Chapters on Goals and Approach and Guiding Growth, plus any others that interest you. Chapters are boldly labeled to facilitate selective reading; or
- **ENTIRELY**. Read the full summary for a fuller understanding of the highlights of the SENE Study.

- In one day or less

TO UNDERSTAND THE DETAILS

Read the **REGIONAL REPORT**.

- **SELECTIVELY**. It is organized exactly like the summary. Wherever your interests lie, you can turn to those sections for additional background, amplifications, analysis of rejected alternatives, and especially for the full text of each recommendation, including who should do what and when. Also, remove the Development Capabilities Maps in the rear pocket and examine the legend to appreciate the type of information the maps portray; or
- **ENTIRELY**. Read the full report for full appreciation of all recommendations, and how they interrelate.

- In an additional 10 minutes to 2 hours

FOR APPLICATION TO YOUR AREA

Get the **PLANNING AREA REPORT** for your locale. Scan it or read it to see how the broader recommendations presented in the Regional Report may apply to the area where you live or work.

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OVERVIEW

Boston Metropolitan Planning Area

What is the point of the SENE Study program?

Balanced use and conservation of the region's water and related land resources is the program's objective. The Southeastern New England (SENE) Water and Related Land Resources Study was authorized by Congress and funded in 1971 in response to the increasingly troublesome pressures the region's rapid urbanization was exerting on its rich and varied natural resources. The SENE Study has two major goals:

- To recommend actions for all levels of government and private interests to secure for the people of the region the full range of uses and benefits which may be provided by balanced use and conservation of the region's water and related land resources.
- To assemble, at a consistent scale and level of detail, information on the resources.

What makes this Study different from others is that it is regional in scope, it comprehensively covers the full range of water and related land resource issues, and it proposes coordinated actions for all levels of government and private interests.

What does the SENE Study program cover?

- (1) To accommodate anticipated growth in environmentally and economically acceptable ways, municipalities should prohibit or restrict development on Critical Environmental Areas such as wetlands, flood plains, and well sites. Growth should be guided to Developable Areas which cover about 25 percent of the planning area. Within this category, municipalities should manage development on resources such as steep slopes, ledge, and soils with septic limitations. Development should be encouraged where services already exist or are planned.
- (2) To supply sufficient amounts of water, local ground water and surface water resources should be protected, developed, and managed where available and feasible. The Metropolitan District Commission's water supply sources will have to be expanded and extended elsewhere.
- (3) To maintain and improve water quality, many towns should treat wastewater at regional facilities. Urban runoff must be monitored and attenuated at new developments. Pumpout facilities should be provided for watercraft wastes.
- (4) To meet recreation needs, better transportation should be provided to nearby beaches, state parks, and to the Boston Harbor Islands. The latter should be developed according to ongoing recreation plans. Funds for recreation should be used to make multiple uses of land owned for public purposes or to enlarge existing recreational facilities.
- (5) To develop renewable and non-renewable marine resources in an ecologically and economically sensitive manner, offshore fishing activities should be limited within a 200 mile zone. The fishing industry should be revitalized by managing offshore fishery resources, by repealing certain laws, by improving Boston Fish Pier, and by developing aquaculture. Important navigation channels in harbors should be maintained, perhaps even deepened.

What will the program do?

If the recommended actions are carried out, most 1990 needs for water, sewers, electric power, and outdoor recreation could be met using existing infrastructure, legal authorities, and institutional designs. Protecting Critical Environmental Areas will avoid potential dangers to life and property from flooding, erosion, and contamination of water quality and provide highly productive greenbelts. As a result, new growth in this planning area can be accommodated without harming the high quality environment which attracted the growth in the first place.

You can take the first step in helping to carry out the program by reading the recommendations in the SENE Study's Regional Report and this Planning Area Report. Write your state and Congressional representatives about the Study. Urge your local planning and conservation officials to use the SENE Study planning process when developing or implementing master plans, zoning ordinances such as flood plain and watershed protection, and other water and land use decisions.

RECOMMENDATIONS

GUIDING GROWTH (Chapter 3)

1. Protect priority Critical Environmental Areas.
2. Restrict development on other Critical Environmental Areas.
3. Manage growth on Developable Areas.
4. Use SENE resource development capability analysis to guide future growth.
5. Accommodate growth where services already exist.

WATER SUPPLY (Chapter 4)

1. Expand MDC sources by completing the Northfield Mountain Facility and carrying out conservation measures; plan the Millers River Facility.
2. Protect ground water sources in Everett and Woburn.
3. Extend MDC service to supplement sources in Wellesley, Natick, and Dedham.
4. Expand the capacity of Echo Lake to serve Milford.
5. Develop ground water sources to serve Franklin, Medway, and Wrentham.
6. Develop ground water supplies in other Upper Charles municipalities.
7. Maintain and upgrade ground water sources in Canton and Norwood.
8. Develop ground water sources in Sharon to meet 1990 needs.
9. Develop Willett Pond in Walpole for supplementary supplies.
10. Extend MDC service to Westwood and Stoughton.
11. Expand the Richardi Reservoir to serve Braintree, Holbrook, and Randolph.
12. Treat existing standby wells in Weymouth to meet 1990 needs.
13. Make best use of local resources in south coastal municipalities.

WATER QUALITY (Chapter 5)

1. Carry out current Massachusetts non-degradation policies.
2. Attenuate runoff from new urban developments.
3. Begin stormwater and wet-weather stream sampling.
4. Continue current industrial permits program.
5. Give additional consideration to several land disposal sites.
6. Connect southern Bellingham to the Woonsocket treatment facility.
7. Expand Medfield's treatment facility to serve Millis, if possible.
8. Construct advanced facility in the middle Charles basin to serve western suburbs.
9. Construct advanced facility in Canton to serve southern suburbs.
10. Study and define the landfill leachate problem.
11. Provide pump-out facilities for watercraft wastes.

OUTDOOR RECREATION (Chapter 6)

Swimming

1. Study best method to widen and protect Nantasket Beach.
2. Improve access along the Dorchester waterfront.
3. Improve facilities at Wollaston Beach, Merrymount Park, and Blacks Creek marsh.
4. Construct one bathhouse at City Point-Carson Beach area.
5. Provide parking and access to Moswetuset Hummock.

Recreational Boating

6. Establish state boating advisory committee.
7. Consider fore-and-aft mooring practices.
8. Continue maintenance of 13 recreation channels.
9. Develop boat ramps and parking facilities.

General Outdoor Recreation

10. Complete developing Boston Harbor Islands Park.
11. Improve inner-city recreation opportunities.
12. Designate the Charles an initial component of scenic rivers system.
13. Expand the Mystic River Reservation.
14. Develop a park behind the Amelia Earhart Dam in Somerville and Everett.
15. Acquire parts of the surplused Chelsea Naval Hospital.
16. Develop Middlesex Fells Reservation and expand Blue Hills Reservation.

17. Expand Wompatuck State Park.
18. Expand Rocky Woods, Noon Hill, and Hale Reservations.
19. Develop Hallet Street Dump for recreation.
20. Connect Neponset River Reservation and Blue Hills Reservation with a stub of land near I-95.
21. Acquire access to Massapoag Lake.
22. Develop guidelines for low-intensity outdoor recreation on secondary reservoir lands.
23. Use Critical Environmental Areas identified on SENE Development Capabilities Map (Plate 1).

Wildlife and Fisheries

24. Use Natural Resources Planning Program to enforce wetlands protection legislation.
25. Use Self-Help Funds to acquire significant wetlands.
26. Acquire public access to potentially most productive streams.
27. Change Great Ponds legislation and acquire access to potentially most productive ponds.

MARINE MANAGEMENT (Chapter 7)

Port Development

1. Develop a regionwide port development strategy.
2. Maintain nine channels in Boston Harbor.
3. Consider deepening two channels in Boston Harbor.
4. Attract private investments to the Port of Boston.
5. Improve Fort Point Channel.
6. Relocate work boats upstream of Northern Avenue Bridge to Pier 7.
7. Consider a new marina between Northern Avenue and Congress Street.

Commercial Fishing

8. Study upgrading Boston Fish Pier.
9. Consider developing a new fish pier in Boston Harbor.
10. Continue to support an interim 200-mile offshore economic zone.
11. Support national fisheries management policy.
12. Improve market for underutilized fish species.
13. Accommodate coastal fish facilities through improved planning.
14. Allow privately financed purchase of foreign-built fishing vessels.

Urban Waterfronts

15. Coordinate local waterfront planning and development.
16. Provide guidance and set criteria for priority waterfront uses.
17. Review and coordinate waterfront use.
18. Support state and local waterfront development plans.

Offshore Sand and Gravel

19. Develop a policy and program regulating commercial mineral extraction in coastal waters.
20. Coordinate future leasing of far-shore sand and gravel sites.
21. Develop predictive modeling techniques for offshore sand and gravel operations.

FLOODING AND EROSION (Chapter 8)

1. Develop a flood plain management program for the Neponset Watershed.
2. Apply structural solutions selectively.
3. Study flooding problems in Braintree.
4. Adopt flood plain zoning preventing adverse flood plain development.
5. Establish local sediment and erosion control ordinances.
6. Establish forest buffer zones.
7. Establish local regulations to ensure flood plain protection.
8. Acquire significant wetlands and flood plains.
9. Locate in existing safe buildings in the flood plain.
10. Encourage natural stabilization of coastal erosion areas.

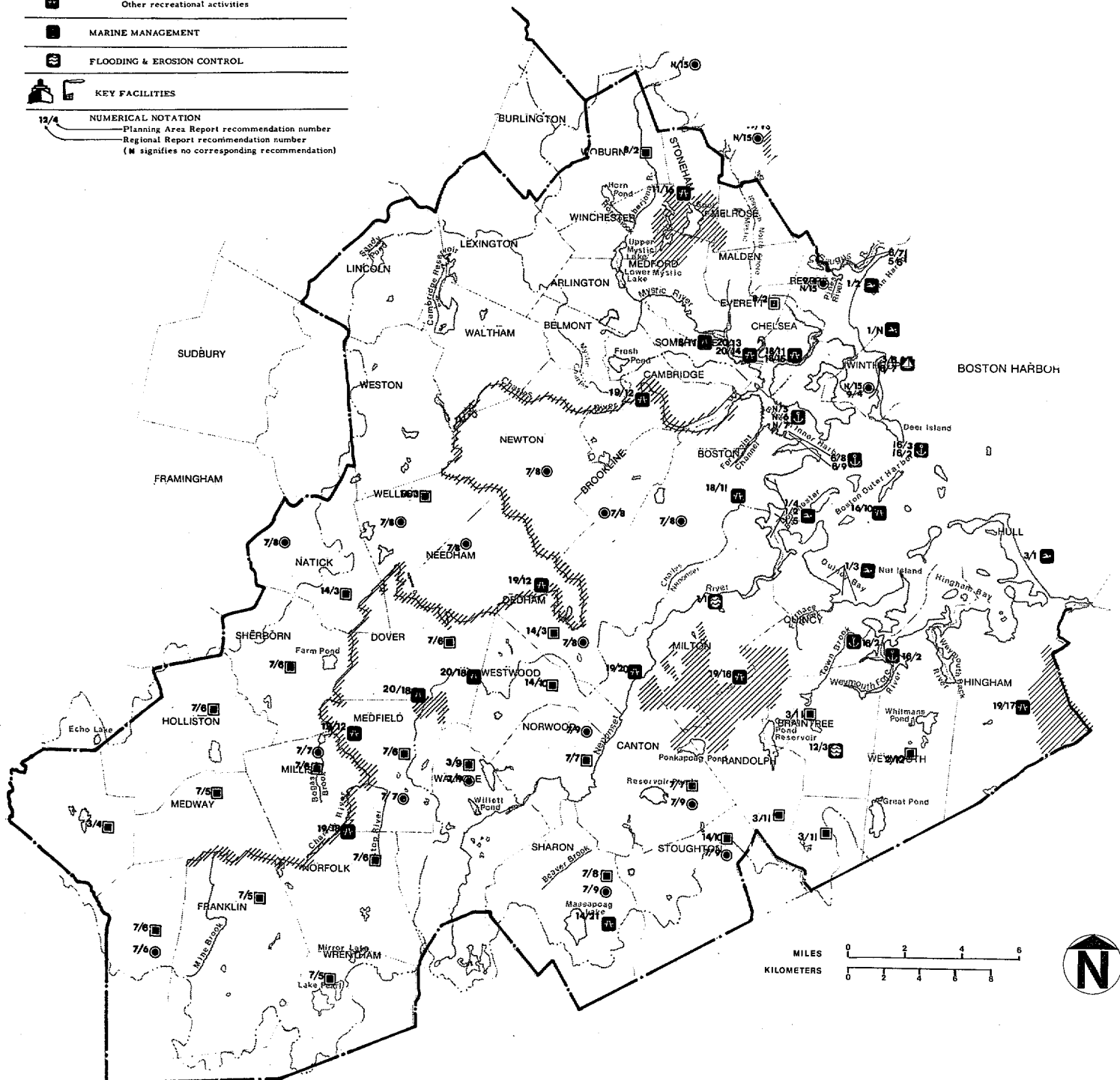
LOCATING KEY FACILITIES (Chapter 9)

1. Study deepwater port facility off Metropolitan Boston within a New England-wide context.

Legend

	WATER SUPPLY
	WATER QUALITY
RECREATION	
	Swimming & Public beaches
	Boating & marinas
	Fisheries & wildlife
	Other recreational activities
MARINE MANAGEMENT	
	FLOODING & EROSION CONTROL
KEY FACILITIES	
	NUMERICAL NOTATION
12/4	Planning Area Report recommendation number
	Regional Report recommendation number
(M signifies no corresponding recommendation)	

The symbols on this map represent the recommended actions that can be shown on a town-by-town basis. The symbols are placed roughly within each town, and are not intended to be more specifically sited than that.



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS

SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY



Boston Metropolitan Planning Area
Recommended Actions

CHAPTER 1 THEMES

This report on the Boston Metropolitan planning area is one component of a comprehensive program for managing water and related land resources in the Southeastern New England (SENE) region. The Study's Regional Report has presented recommended policies and actions from a regionwide or statewide perspective. This Planning Area Report includes applications of those broad-based recommendations to the municipalities found in the Boston Metropolitan planning area.

One reason for preparing Planning Area Reports is to connect the actions at the local level with the policy framework and considerations for state and federal levels. This direction was chosen as a response to the region's long history of local autonomy and to the Study's emphasis on placing decision-making at a level commensurate with the anticipated scope of the decision. The planning area boundaries follow the town lines most closely approximating the hydrologic boundaries of river basins.

Three common themes link all SENE's reports:

- **Enhancing the environment enhances the economy.** The region's reputation as a pleasant place to live will have to be maintained in order to attract the highly skilled workers characteristic of a service economy. This need is especially clear in the Boston Metropolitan planning area, the economic center for the Massachusetts portion of the SENE region.
- **Anticipated growth can be accommodated, but it needs guidance.** The SENE program represents a powerful beginning. The planning area is embraced by Routes 495 and 128 which will continue to encourage population growth. Municipalities therefore have a special need to plan new development.
- **Existing knowledge, programs, and institutions provide the most realistic tools for achieving results, but**

some changes are needed. Full use of ongoing programs, with some changes in how they relate to each other, was viewed as a way of "piggy-backing" on programs which have already weathered most of the realities of the political process. In choosing this strategy the Study traded off novelty to increase achievability.

Each major chapter in this report contains actions to solve water and related land problems which we face now, or can expect to face in the next 15 years, and, in some cases, into the next century. Table 1.1 shows the intensity of these problems within each planning area, between them, and for the region as a whole. Of the seven subjects studied, four are severe problems in the Boston Metropolitan planning area:

- **Guiding Growth.** New population and economic growth could substantially change the existing high environmental quality presently pervading the environment.
- **Water Quality.** Water quality improvements in this planning area could benefit more people than any other part of the SENE region.
- **Water Supply.** The existing water supply systems cannot satisfy future demands.
- **Outdoor Recreation.** The availability of resources for swimming, boating, hunting, and extensive outdoor recreation are especially limited in this most densely populated planning area.

Other major problems in the planning area focus on Boston Harbor: managing the development of New England's most important port; improving the urban waterfront, cut off from Boston by the Southeast Expressway; deciding if, and where, to site petroleum related facilities.

TABLE 1.1 GENERAL INTENSITY OF SENE WATER - RELATED PROBLEMS BY PLANNING AREA

Key ● Severe problem ○ Major problem • Moderate problem Blank Minor or no problem	GUIDING GROWTH (Overall)														
	Protection of Critical Environmental Areas					Management of Developable Areas					WATER SUPPLY				
	WATER QUALITY (Overall)					Combined Sewers/Urban-Runoff					Municipal Discharges				
	Industrial Discharges					Low Streamflow					Septic Systems				
	Agricultural Runoff					Landfill Leachate					Oil Pollution				
	Land Use Discharge					Watercraft Wastes					RECREATION (Overall)				
	Swimming					Boating					Recreational Saltwater Fishing				
	Camping and Picnicking					Access to Hunting and Fishing Opportunities					Passive Outdoor Recreation				
	MARINE MANAGEMENT (Overall)					Offshore Fisheries					Shellfish and Aquaculture				
	Port Development					Offshore Sand and Gravel					Urban Waterfronts				
FLOODING AND EROSION (Overall)															
Inland Flooding					Coastal Flooding					Inland Erosion					
Coastal Erosion					LOCATING KEY FACILITIES (Overall)					Availability of Sand and Gravel					
Power Plant Siting					Petroleum Facilities Siting					Solid Waste Management					

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CHAPTER 2 THE SETTING

The Boston Metropolitan planning area consists generally of all the land that drains into Boston Harbor. The area covers about 640 square miles (or about 409,000 acres). The 49 towns in the planning area include:

Arlington	Hingham	Millis	Stoneham
Bellingham	Holbrook	Milton	Stoughton
Belmont	Holliston	Natick	Walpole
Boston	Hull	Needham	Waltham
Braintree	Lexington	Newton	Watertown
Brookline	Lincoln	Norfolk	Wellesley
Cambridge	Malden	Norwood	Weston
Canton	Medfield	Quincy	Westwood
Chelsea	Medford	Randolph	Weymouth
Dedham	Medway	Sharon	Winchester
Dover	Melrose	Sherborn	Woburn
Everett	Milford	Somerville	Wrentham
Franklin			

Three major rivers, the Mystic, Charles, and Neponset, drain most of the area. The Mystic follows a southeasterly course over generally flat countryside from its headwaters in Lower Mystic Lake (Winchester) to its mouth in Boston's Inner Harbor. The 79 mile long Charles rises in Hopkinton and flows through moderately rolling countryside to Boston Harbor. Wetlands are abundant in the more rural towns, and many ponds and lakes are scattered throughout. The recent Corps of Engineers Charles River Study determined that a forty percent loss of Charles River wetlands could increase flood stages in the middle and upper river from two to four feet, for a flood of the magnitude experienced in 1968. The Neponset meanders northeastward 28 miles from Foxboro, through the extensive Fowl Meadows to Dorchester Bay. Ground water of good quality to support low population densities is available in many parts of the planning area, but urban areas must import water.

Underlain for the most part by metamorphic rock the planning area's surface topography, soils, and highly articulated coastline were formed by the last glacier about ten thousand years ago.

The shoreline in this planning area is about 130 miles long, 100 on the mainland and 30 on some 31 islands. Essentially all of the island shoreline and 17 miles along the mainland are beach. The remaining shoreline consists of bulkheads and revetments (47 miles), rocks (15 miles), or bluffs, marshes, and salt flats (6 miles).

Nearly half (44 percent) of the people in the SENE region live in this planning area, some of them in the most densely populated municipalities in the region. The population has risen slowly from 2.0 million in 1960 to about 2.1 million

in 1970. According to the Study's projections it will climb slightly to less than 2.3 million in 1990 and about 2.4 million in 2020. The anticipated growth rates for the Boston Metropolitan planning area between 1970 and 1990, and 1970 and 2020, are roughly 10 percent for each period. These anticipated growth rates are about half the region's growth rate anticipated over the next 20 years and about a quarter of that expected over the next 40 years. This planning area's anticipated growth rates are also lower than those expected for the United States as a whole, by over half for the 20 year period, and about a fifth for the 40 year period.

Within the planning area, however, the population is not so stable. *Chapter 3, Guiding Growth*, indicates that development pressures are high around the urban fringe, but decline slightly in the core — thus reflecting nationwide urban trends.

Per capita income in 1970 averaged \$3965. This is by far the highest level in SENE and is 16 percent above the national average. With a work force of 1.0 million, the area employs more than half the workers in SENE. They work in a diversified economy. A third are in the service sector. The remaining two-thirds is split about evenly between manufacturing, the retail trades, and everything else. During the 1960's, 134,000 new jobs were added. About two-thirds were in the service sector — utilities, personnel and business, medical, private education, consulting, and research and development. Retail activities accounted for another quarter of the new jobs. Manufacturing declined by 41,000 or 17 percent. This pattern reflects trends going on throughout SENE region, as described in *Chapter 2 of the Regional Report*.

Early in the Study, participants at public workshops voiced a preference for greater self-sufficiency in water supply, treatment of all combined sewer flows, intensifying wetlands management and acquisition, and expanding all kinds of outdoor recreation opportunities. Of great concern among workshop participants was the spread of urban development.

Later, during the 90-day review period, over 275 state, regional, and municipal officials, federal agencies, and concerned citizens submitted comments on the Study's draft reports. The major comments are summarized in a Regional Report chapter, "*Review of the Report*."

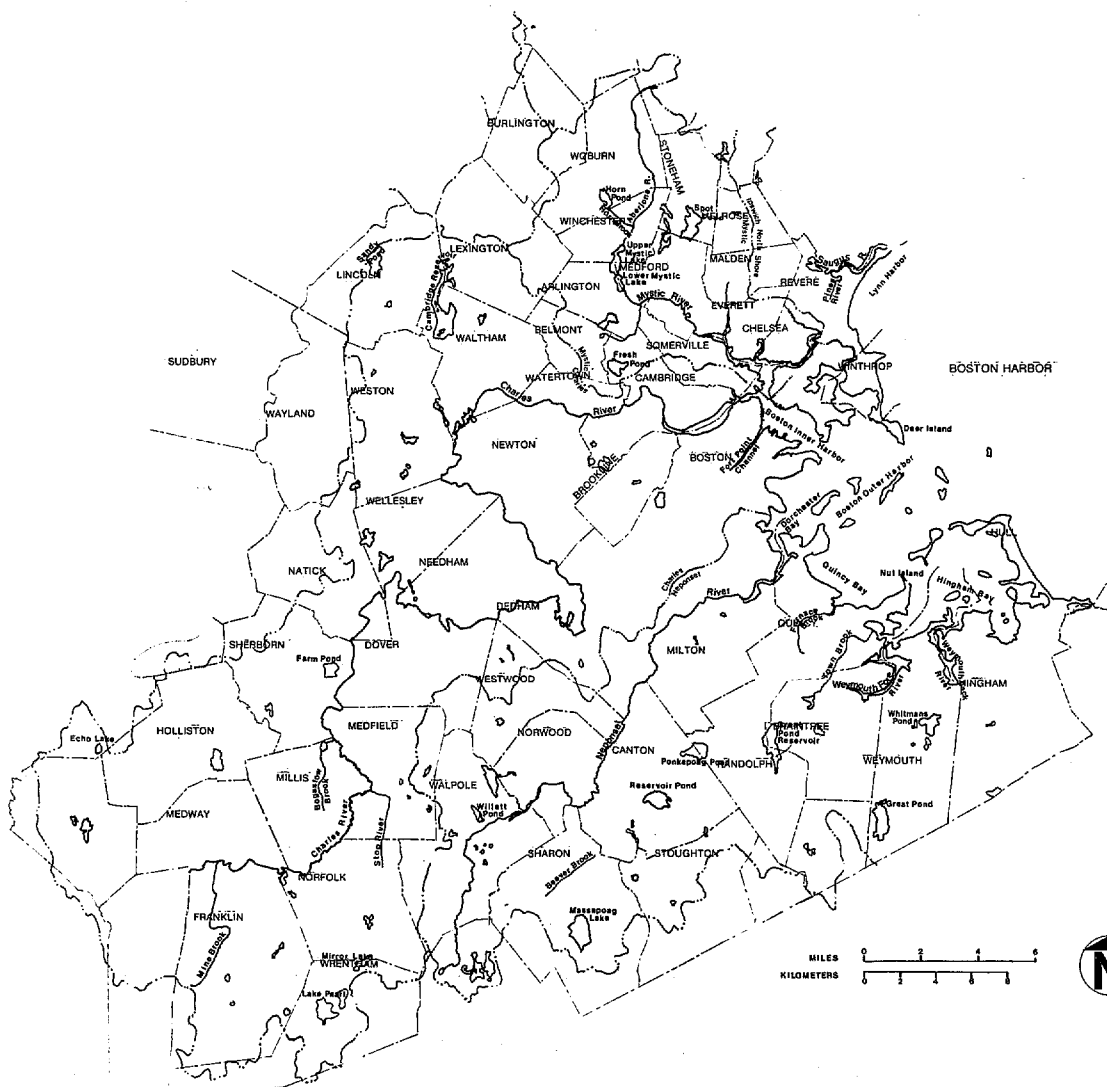
There are several major changes in the Boston Metropolitan Planning Area Report. In response to the concerns of citizens in the SENE region and the Connecticut Valley, the recommendation in *Chapter 4* for diversion from the Connecticut River basin now reflects the qualifications on the

Millers River diversion from the 1980 Connecticut River Basin Plan and the many options available for study, including water conservation. The regional water district recommended to serve Milford, Franklin, Wrentham, and Medway has been replaced with two new recommendations, expanding Echo Lake to serve Milford and developing local ground water supplies to serve the other three communities. Local authorities pointed out that a regional water supply source could not adequately satisfy demands projected for the four communities. *Chapter 5* now includes the suggestion that the Commonwealth review and update regulations for siting septic systems due to public discontent with existing regulations. A recommendation to develop an esplanade along Tenean Beach was dropped from *Chapter 6* because of questions of propriety and of safety raised by Massachusetts Audubon Society and the Metropolitan District Commission. In response to the Massachusetts Division of Water Resources and the Charles River Watershed Association, *Chapter 6* suggests the Commonwealth restore public rights to mill ponds and pursue a program to restore mill dams when the public interest is at stake. The discussion of the Boston Harbor Islands plan was updated to reflect recent accomplishments in implementation. Instead of recommending that the Commonwealth restrict sand and gravel mining in ocean depths less than 100 feet, *Chapter 7* reflects the state's intentions to develop a policy and program regulating mineral extraction activities in coastal waters. Finally, a recommendation to consider a power generating facility on Deer Island was dropped from *Chapter 9* because of conflicts with existing facilities men-

tioned by the Sierra Club and Metropolitan District Commission.

Several implications stand out from the preceding profile.

- (1) The physical, social, and economic health of the Boston Metropolitan planning area is the key to the future of not only Southeastern New England but the entire New England region as well.
- (2) Development pressures surrounding the urban core indicate that many families prefer life in an improved natural and social environment. Increasing pressures imply a need for adjustments in established utilities, transportation, and taxation systems.
- (3) The pronounced move towards a services-oriented economy promises less strain on the area's land, air, and water resources. It also requires a high quality environment to attract and hold creative and highly skilled workers. Thus far, the "brain drain" has favored Boston, but the city's future health, and, therefore, that of the region, rests largely on its ability to keep that flow from reversing.
- (4) Like every large city the world over, to provide income Boston must rely upon the resources of its hinterland. Making Boston become self-sufficient in water resources is unrealistic.



NEW ENGLAND RIVER BASINS COMMISSION
BOSTON, MASSACHUSETTS



SOUTHEASTERN NEW ENGLAND
WATER AND RELATED LAND RESOURCES STUDY

TOWNS AND RIVERS
IN THE PLANNING AREA

FIG.
NO.
2.1

CHAPTER 3 GUIDING GROWTH

Although the Boston Metropolitan planning area is the economic and population center of New England, over half the planning area (using 1970 figures) is non-urban and exists as water (6 percent), forest (42 percent), open space (5 percent), or agriculture (1 percent). This picture will change over the next 50 years — perhaps substantially — due to new land development resulting from population and economic growth.

There is a growing concern about where this development will occur and how it will affect land and water resources. These resources constitute high environmental quality which *Chapter 2 of the Regional Report* shows to be vital for the region's economic health. The SENE Study has concluded that the growth anticipated for the Boston Metropolitan planning area can occur without significantly changing the existing environmental quality, as long as certain steps are taken. This chapter describes the anticipated growth and the capacities of the resources to accommodate it. The last section recommends strategies to guide growth in an economically and environmentally acceptable manner.

The Situation

Anticipated Growth

Chapter 2 of this report describes the Boston Metropolitan planning area as the most densely populated in the SENE region. Yet the planning area embraces a rich natural landscape literally within minutes of an urban center. The amount of land which is urban (some 41 percent of the planning area in 1970) is about twice the average for the region (some 20 percent of the total regional area in 1970). According to SENE Study single-purpose inventory informa-

tion, about 60 percent of the urban area is high intensity use (commercial, residential of multi- and single-family units on less than half acre lots, institutional). Medium intensity urban uses (single-family lots on half acre to one acre lots) occupy about 9 percent of the urban area. The remaining urban area is nearly evenly divided among industrial uses, transportation, extraction/disposal, and low intensity urban uses (single-family dwellings on lots greater than one acre).

This situation came about because population and employment between 1960 and 1970 resulted in a 20 percent increase in the area covered by urban development, from about 142,000 acres in 1960 to about 171,000 acres in 1971. This was much smaller than the regional increase in urban area of 45 percent, but still a rather rapid consumption of land; for every increase of 2.4 persons, one acre of undeveloped land was converted to urban use during the sixties.

Between now and 1990, the rate of population increase will about double the 1960-1970 rate (*Chapter 2 of this report*), before slowing down to a fairly stable population by 2020, if the present birth rate continues. If the current land consumption rate continues, half of the planning area's remaining 250,000 undeveloped acres could be urbanized by 2020.

The rates at which parts of the Boston Metropolitan planning area will be urbanized will vary to some extent with relative development pressures. These pressures were estimated for SENE communities on the basis of factors such as the growth rate of industrial, commercial and other uses, the relative accessibility of an area to employment and population in other parts of the region, and the availability of easily developable land. The process for grouping towns by development pressure is defined in *Chapter 3 of the Regional*

TABLE 3.1 MUNICIPALITY BY DEVELOPMENT PRESSURE: BOSTON METROPOLITAN PLANNING AREA

High		Medium High		Medium Low	Low
Bellingham	Canton	Arlington	Norfolk	Winchester	Belmont
Dedham	Norwood	Stoneham	Waltham	Boston	Chelsea
Franklin	Sharon	Woburn	Wellesley	Cambridge	Everett
Holliston	Stoughton	Brookline	Wrentham	Milford	Malden
Lexington	Walpole	Dover	Westwood	Millis	Medford
Medfield	Braintree	Lincoln	Holbrook	Weston	Melrose
Medway	Hingham	Needham		Milton	Somerville
Natick	Randolph			Hull	Newton
Sherborn	Weymouth				Watertown
					Quincy

* Other factors may result in a different picture; MAPC studies, for example, indicate slow growth for Arlington and Brookline, and more significant growth for Millis and Weston.

Report. In general, combining these factors resulted in an indication of development pressure on the municipalities in the planning area relative to all SENE communities as shown on Table 3.1.

Accommodating Growth

To assess the implications of growth for land and water resources in the SENE region, the SENE Study first identified and quantified them. Table 3.2 describes three major categories of resources, each differing according to development capability. There are two kinds of Critical Environmental Areas: Priority Protection (Category A) and Other Protection Areas (Category B). Category A includes water bodies, wetlands, beaches, and critical coastal erosion areas. Intensive

use of these critical resources might constitute a threat to public health, safety, and welfare. Development of resources such as flood plains, prime agricultural soils, unique natural and cultural sites, upland erosion areas, and proposed reservoir sites and related watersheds (Category B), have certain environmental, economic, and social costs. Some development is compatible with recharge areas for high yield aquifers, best upland wildlife habitat, high landscape quality areas, ledge and/or steep slopes and soils with severe or moderate septic limitations (Category C, F, and G), if it is restricted so as not to damage intrinsic qualities. Use of the remaining area is preempted by existing development (Category E) or public ownership (Category D). But it is worth noting that developed areas can be used – and further, that use and reuse of such land can be highly efficient.

TABLE 3.2 THE SENE RESOURCE DEVELOPMENT CAPABILITY SYSTEM

CRITICAL ENVIRONMENTAL AREAS REQUIRING PROTECTION

Water Bodies (Category A), blue. [Includes estuaries, shellfish flats, and fish spawning areas.]

Priority Protection Areas (Category A), dark green: wetlands, well sites, beaches, and critical coastal erosion areas.

Other Protection Areas (Category B), light green: flood plains, class I and II agricultural soils, unique natural and cultural sites, [proposed reservoir sites and related watersheds, and upland erosion areas] excluding all "A" areas.

DEVELOPABLE AREAS REQUIRING MANAGEMENT, Excluding All A & B Areas

WATER RESOURCE LIMITATIONS

Aquifers and/or Recharge Areas (Category C₁) black dots: highest yield aquifers in each basin.

WILDLIFE AND SCENIC RESOURCE LIMITATIONS

Wildlife Habitat (Category C₃), black diagonal lines: best upland wildlife habitat other than publicly owned land and [commercial fishing grounds].

Landscape Quality Areas (Category C₂), black vertical lines: land characterized by high landscape quality other than categories C₁ and C₃.

SOILS RESOURCE LIMITATIONS

Ledge and/or Steep Slope (Category C₅), brown: land with slope greater than 15 percent and/or with rock near the surface.

Severe Septic System Limitations (Category C₄), orange: land with severe septic system limitations other than Category C₅.

Moderate to No Septic System Limitations (Categories F and G), yellow: land with moderate or no septic system limitations.

PREEMPTED USE AREAS

Urban Areas (Category E), gray: residential^{5/} institutional, commercial and industrial development.

Publicly Owned Lands (Category D), beige: major public parks, forests, watersheds, and military lands.

Notes:

- ^{1/} All categories above, except those within brackets, are depicted on the development capabilities maps (plates 1, 2, 3).
- ^{2/} Categories in brackets are included to show where they would fit in the overall classification hierarchy, were they included on the plates in the pocket.
- ^{3/} All categories above, including those within brackets, are depicted on large-scale, unpublished maps available for inspection as part of the SENE Files.
- ^{4/} Categories C₁, C₂ and C₃ overlap with categories C₄, C₅, F, or G. Thus, Category C₃-C₄ is a wildlife habitat located on ledge or steep slopes.
- ^{5/} Mapped urban areas (Category E) include all-residential development, although the legend on Plates 1, 2, and 3 reads "residential areas on less than one acre lots."

These land and water resources for the Boston Metropolitan planning area have been mapped on Plate 1 and the percent of the planning area in each category is displayed on Table 3.3.

As mentioned earlier in this chapter, about 40 percent of planning area has been already developed. Boston and the surrounding towns account for most of the existing urbanized land. These urbanized areas embrace an infrastructure, including a wastewater system which serves 87 percent of the total planning area population. Seven (7) percent of the planning area is publicly owned. Most of the publicly owned lands are in open space, recreation, water supply, or related uses. These combined amounts of urbanized and publicly owned lands (47 percent) are a higher percentage of the total planning area than that for the SENE region (33 percent).

Critical Environmental Areas (Category A and B) comprise nearly a quarter of the total Boston Metropolitan planning area. This proportion is lower than the percentage of Critical Environmental Areas for the SENE region (33 percent).

The diversity of these resources contributes significantly to the richness of the environment mentioned earlier in this chapter.

Category A resources occupy about 14 percent of the planning area. The last major tidal salt marsh near the Boston urban area is at the mouth of the Neponset River. Inland wetlands however, are abundant, particularly in the Charles and Neponset River basins. Towns which have significant concentrations of wetlands include: Medfield, Millis, Norfolk, Needham, Dedham, Sherborn, Holliston, Norwood,

Canton, Braintree, and Weymouth. Wetlands are prime targets for development; between 1960 and 1970, 23 percent of the planning area's fresh water (non-wooded) wetlands, and 30 percent of the salt water wetlands were lost.

Chapters 6 and 8 of this and the Regional Report, discuss the value of wetlands for flood storage, water supply, plant and wildlife habitat, and other purposes.

All three basins have large amounts of riverine flood plain (the planning area contains about 40,000 acres, the second highest among the planning areas), upon some of which extensive development has aggravated flooding problems (see Chapter 8). Towns bordering the mainstem Charles have sizeable inland flood plains, especially Medfield, Millis, Norfolk, Sherborn, Dedham, Wellesley, and Weston. Lexington and Holliston are other basin towns with substantial flood plains. In the Neponset River basin and South Shore towns, Norwood, Canton, Walpole, Sharon, Hingham, Weymouth, and Braintree have large amounts of inland flood plains. Woburn, Winchester, Arlington, and Belmont are towns in the Mystic River basin which have large amounts of inland flood plains.

Prime agricultural lands are scarce in this planning area (Medway, Norfolk, Franklin, and Holbrook do, however, have several areas), and are major targets for development. *Chapter 3 of the Regional Report* discusses the significance of the rapid loss of these areas.

The planning area has numerous unique historical sites, mostly in the Boston area; archeological sites on the Bogas-tow Brook (a tributary of the Charles) and the Boston

TABLE 3.3 PERCENT OF LAND AND WATER RESOURCE CATEGORIES IN EACH PLANNING AREA

Planning Area	Total (in 1000's of acres)	Percent (%) of Planning Area				
		Critical Environmental Areas			Develop- able Areas	Preempted Use Areas
		A	B	A & B	C, F, G	D, E
Ipswich-North Shore	274	19	13	32	34	34
Boston Metropolitan	421	14	9	23	30	47
South Shore	172	17	13	30	43	27
Cape Cod & Islands	378	10	23	33	32	35
Buzzards Bay	205	17	16	33	47	20
Taunton	351	19	22	41	37	22
Blackstone & Vicinity	410	10	11	21	38	41
Pawtuxet	180	11	7	18	41	41
Narragansett Bay	212	16	16	32	34	34
Pawcatuck	262	27	12	39	40	21
SENE	2,865	16%	15%	31%	36%	33%

Sources: See Methodology in the Regional Report.

Harbor Islands; and natural sites such as in the Millis-Holliston and Boston-Brookline-Newton area, the valued character of which could be damaged by incompatible development.

Developable Areas comprise nearly a third of the total planning area (some 125,000 acres). A large proportion (100,000 out of the region's 530,000 acres of the developable areas are lands of high landscape quality (defined by landscape diversity and relief). Valuable landscape is found in Milton, Sharon, Weston, Lincoln, Lexington, Waltham, the area of Milford in the upper Charles River, and straddling the borders of Winchester and Arlington. Other developable areas are those with slopes of over 15 percent, which are scattered in small areas throughout the planning area. Development of these causes risk of erosion and septic system seepage to areas below. Density of development on soils with severe septic tank limitation (12,000 acres in the area with much in the western portion of the Charles River basin) must be regulated according to availability of sewers. Some 8,000 acres are predominately ledge — either exposed, or within three feet of the surface — which offers little development potential despite its physical attractiveness and aesthetic quality. Table 3.4 presents suggested guidelines for suitable use of Developable Areas mapped on Plate 1.

A pertinent question is how much of the projected population could Developable Areas accommodate. The land consumption rate for the Boston metropolitan planning area between 1960 and 1970 was about 0.4 acres for each additional person. This is somewhat less than the regional land consumption rate of 0.5 acres per person. Assuming a continuation of land consumption trends within the planning area, 293,000 persons could be accommodated by the planning area C, F, and G lands. This is more than the anticipated 188,000 persons projected for the planning area by 1990, and even somewhat more than the 283,000 projected by 2020. Should the land consumption rate increase to the regional rate, 248,000 persons could be accommodated — still more than the projected 1990 population, but less than the projected 2020 population. The capacity to accommodate additional growth appears certain in yet another sense. The additional sewer facilities proposed for the planning area would serve 349,000 more persons, more than the population projected for the planning area by 2020.

In addition to land use decisions resulting from the need to accommodate population growth, the planning area faces several decisions about siting large scale facilities. These developments are vital to the economic growth of the planning area and to service the people's needs, but they do have significant impacts on water resources. The demand for power is steadily growing but few sites exist that meet requirements for power plants with minimal degradation of the environment or safety hazards. Sand and gravel consumption in this planning area is the greatest in SENE and large

operations are active in the area. But frequently the best sand and gravel sites are ground water recharge areas and care must be exercised to prevent pollution or depletion of aquifers. These are discussed further in *Locating Key Facilities, Chapter 9*. Similar considerations apply to solid waste disposal and large scale development.

This analysis points to the opportunity existing in the Boston metropolitan planning area to accommodate growth without significantly changing the water and land resources which contribute to the planning area's environmental quality.

Authorities at all levels — federal, state, local, and private — can contribute to meeting this aim irrespective of the scope of the land use decision.

The Solutions




To take advantage of the Boston Metropolitan planning area's opportunity to accommodate growth without significantly changing the overall environmental quality, a strategy with three components is needed: (1) Protect Category A Critical Environmental Areas; (2) Restrict development of Category B Critical Environmental Areas; (3) Manage Categories C, F, and G Developable Areas, guiding growth to existing infrastructure. A statewide structure is recommended below to carry out the program. In the time before institution of such a structure, however, municipalities can implement many of these recommendations with the technical and financial assistance of regional planning agencies and state agencies.

A number of methods are available for protecting the fragile Critical Environmental Areas listed in Table 3.2. These include existing legislation, zoning, building codes, subdivision regulations, and outright purchase. Within the context of existing methods the Study recommends for Priority Protection Areas:

- 1. Protect priority Critical Environmental Areas.**
Municipalities should prohibit urban development on Category A Critical Environmental Areas (Priority Protection Areas). The appropriate uses of these resources include: water supply, fisheries production, limited recreation, or scenic and open space lands.

Planning and zoning boards should protect water bodies from pollution by restricting adjacent development and by controlling urban runoff through subdivision regulations requiring stormwater detention ponds where feasible. The recommendations in *Chapter 5 of this report* will also help to achieve the state's water quality standards. **Estuaries and shellfish flats** — particularly those along the lower Neponset River in Hingham, Quincy, and Dorchester Bays, and among

TABLE 3.4 SUGGESTED* GUIDELINES FOR USE OF DEVELOPABLE AREAS SHOWN ON PLATES 1, 2, and 3

MAP COLOR	MAP PATTERN	NONE (color only)			
	Other Resource Limitations Soils Limitations	No other Resource Limitations	High Landscape Quality (Category C ₂)	Upland Wildlife Habitat (Category C ₃)	Aquifer and/or Ground water recharge areas (Category C ₁)
YELLOW	Moderate to No Limitations for septic system disposal (Category F & G)	- PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.0 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PW only . Med. Intensity I/C . At least 1/2 ac/DU Unclustered - . Med. Intensity I/C . At least 1/2 ac/DU Unclustered or no PW & PS - . No I/C . At least 3 ac/DU**
ORANGE	Severe septic system limitations caused by conditions other than slope and ledge soils (Category C ₄)	- PW & PS . Any I/C . Any Res. - PW only . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 50% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 30% of area - - PW & PS . Any I/C . Any Res. Unclustered or PW only - . Low Intensity I/C . At least 1.5 ac/DU	If clustered on no more than 20% of area - - PW & PS . Any I/C . Any Res. - PS only . Med. Intensity I/C . At least 1/2 ac/DU - PW only . No I/C . At least 3 ac/DU
BROWN	Ledge and/or steep slope greater than 15% (Category C ₅)	- PW & PS . No I/C . At least 1/2 ac/DU *** - PW only . No I/C . At least 2 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU	. No I/C . At least 3 ac/DU

* These are designed to provide a framework for designing guidelines of increasing specificity by state, regional, and local planners, and consultants more intimately knowledgeable with local circumstances.

** In many cases suggested guidelines for development, particularly for ground water, are estimates of probable safe controls made in the absence of greater knowledge of the effects of development on the pollution of aquifers.

*** Erosion control measures should accompany other restrictions on slopes over 15%.

Med. & Low Intensity - refers to water use/effluent discharge/building coverage

Clustering - refers to percent impermeable land surface area which may adversely effect the resource.

PW - Public Water Supply System

PS - Public Sewer System

I/C - Industry/Commercial

Res. - Residential

ac - acre

DU - Dwelling Unit

islands in the outer portion of Boston Harbor — should be protected by prohibiting outfalls of any kind of effluent and prohibiting dredging, sand and gravel mining, or installation of pipelines in these areas. **Wetlands** should be protected through more rigorous enforcement of existing legislation at a local level. (*Chapter 8 of the Regional Report details how the legislation can be improved; Chapter 6 of the Regional Report discusses kinds of assistance available to municipalities*). Municipalities using Massachusetts Self-Help Funds, and/or private interests should acquire the most valuable wildlife wetlands and surrounding uplands which are mentioned in *Chapter 6 of this report*. **Critical erosion areas and beaches** should be protected by zoning ordinances prohibiting development. Chapter 6 of this report includes recommendations for the recreational development of beaches. *Chapter 8* includes measures for protecting accelerating rates of erosion.

To manage Other Protection Areas, municipalities should:

2. **Restrict development on other Critical Environmental Areas.** Municipalities should restrict development of Category B resources. Suitable uses to be considered for this category should include agriculture, extensive recreation, forestry, or in some cases, with proper management, very low density residential use.

Measures for protecting **flood plains**, described in depth in *Chapter 8 of the Regional Report*, include local flood plain zoning prohibiting development, discouraging or prohibiting reconstruction after substantial storm damages, relocating some public facilities if structural protection is not available or practical. Structural methods required to remedy flooding problems in this planning area are described in *Chapter 8 of this report*. **Prime agricultural lands** should be protected at the state level by tax incentives, agricultural districts, and acquisition of development rights for the highest priority lands, and at the local level by methods such as transfer of development rights. (*See Regional Report, Chapter 3, for more details*).

Proposed reservoir sites and unique natural and cultural sites should be protected by outright acquisition or purchase of easements or development rights. *Chapter 4 of this report* describes recommendations for reservoir development in Walpole and Holliston. **Upland erosion areas** should be protected by local sediment and erosion control ordinances (*discussed in Chapter 8 of the Regional Report*).

The nearly 125,000 acres of Developable Areas (Category C, F, and G resources) require some management to retain the intrinsic natural functions which these resources perform. The SENE Study recommends municipalities:

3. **Manage growth on Developable Areas.**
Municipalities should manage growth on Cate-

gory C resources and encourage growth on Category F and G resources, especially where infrastructure exists or is planned.

It is worth noting that this recommendation deals with management of all developable areas both within existing developed areas, and in areas yet to be developed. There are no developable areas in which management of some kind is not required.

On ground water recharge areas (of which there are about 12,000 acres scattered throughout the planning area), communities should restrict densities so that septic systems will not endanger ground water quality. Densities requiring sewers should be allowed only after analysis of the economic and environmental feasibility of recharge maintenance (*see Chapter 4, Water Supply, and Chapter 5, Water Quality*). Other ordinances and building codes should control coverage by impermeable surfaces, require stormwater detention ponds to recharge runoff from roofs, streets, parking lots, and driveways. Regulations and sound engineering practices should be used to minimize the effects of activities hazardous to ground water quality such as sanitary landfill, highway deicing salt, industrial waste disposal, agricultural runoff, and sand and gravel mining below the water table. On areas with **high landscape quality, best upland wildlife habitat** (especially in Lincoln, Norwood, Canton, Sharon, Woburn, and Medford), and on **unsewered soils with severe septic system limitations**, only development of very low density or in clusters should be allowed. Development that would tend to preempt the resource value of wildlife habitat and landscape quality should be carefully evaluated to ensure that adverse impacts are fully taken into account. **Steep slopes** should be protected from erosion by low density use. Development on **moderate limitation areas** should be regulated to correspond to the availability of sewers. Higher densities should be encouraged on F and G lands, since Category C resources usually can support only very low densities.

The SENE Study findings represent a beginning for all towns to implement this strategy. The information on SENE Development Capabilities Maps covers too large an area to allow use at the site design level of detail. For example, because of scale limitations, portions of the Charles River in its upper reaches and at its headwaters in Hopkinton do not appear. Municipalities can concentrate on developing management guidelines for high priority resources which fit into existing ordinances and building codes using more detailed maps and data. The municipalities which should take the steps most urgently are those under high development pressure and with significant amounts of Critical Environmental Areas, namely: Holliston, Dedham, Sherborn, Norwood, Sharon, Walpole, Canton, Medfield, Lexington, Braintree, Hingham, and Holbrook. Protection of public and industrial water supply wells in Woburn under medium-high development pressures

and industrial water supply wells in Everett under low development pressure is also important according to *Chapter 4, Water Supply*.

Although local governments have much of the authority necessary to implement the concept of guiding growth based on resource capability, its implementation will be most effective if adopted as a matter of state policy. Many resources extend across town boundaries and greater funding resources and additional information are available at the state level.

The most expeditious way for the states to implement these concepts would be for their interagency policy councils to review and adopt, as appropriate, the policy issues suggested herein.

Rhode Island has taken a powerful step in this direction by putting together a comprehensive land use plan. Massachusetts should continue its progress toward developing a comprehensive policy for guiding growth. This decision is most appropriately made by an existing interdisciplinary organization. It is therefore recommended that the Commonwealth:

4. Use SENE resource development capability analysis to guide future growth. The Massachusetts Cabinet, with the active participation of regional planning agencies and municipal government, should review and use the SENE Study's resource development capability analysis to develop a policy for guiding future growth. Guidelines can be developed at the state, substate, or local levels of government. *Chapter 10 of the Regional Report describes several options for developing these guidelines.*

Chapter 3 in the Regional Report describes the economic inefficiencies and environmental detriments of urban sprawl. Making better use of roads, sewer systems, and water supply systems where they already exist could help to avert these costs. Therefore, it is recommended that policies be developed to:

5. Accommodate growth where services already exist. The Massachusetts Cabinet, in concert with

towns, regional planning agencies, and state agencies, should establish policies to accommodate further development in already developed areas, and to permit maximum use of existing water, sewer, and transportation service. Planned unit development and the cluster principle should also be encouraged in these areas.

The Regional Report also recommends establishment of a system for determining criteria for locations of developments of regional impact. This would be within the framework of the system designed to protect critical areas and manage developable areas, and would enable consideration of environmental and economic ramifications of siting decisions. Power plant siting problems in this planning area would be under its jurisdiction. Consistent with siting criteria suggested for other facilities of regional impact, highway planners should give special consideration to avoiding Critical Environment Areas (Categories A and B). *Details of this recommendation can be found in the Locating Key Facilities chapters of this and the Regional Report, and in the Regional Report in the chapters on Strengthening the Management System for Natural Resources and Guiding Growth.*

Implications

The impact of these recommendations on development patterns in the planning area, considering the volumes of area in each category and the projected population, would be beneficial environmentally and economically. The amount of the planning area in Category A and B lands is relatively low (23 percent); only two planning areas have lower percentages. A very high proportion of the area has already been preempted by development and public use, and the Study was not able to estimate the amount of growth that could be accommodated in these areas. But most, if not all, of the growth anticipated over the next 50 years can be accommodated on land and water resources capable of supporting that development with the fewest environmental costs. The amount of sewer service proposed for the planning area is large enough to accommodate the projected population. By directing growth to areas with, or proposed to have, services, municipalities can help meet the goal of accommodating growth with fewest environmental and economic costs.

CHAPTER 4 WATER SUPPLY

The Situation

The previous chapters have indicated that the Boston Metropolitan planning area has the largest population and is the most densely settled of all ten planning areas. Continued growth will result in increased demands for water, especially in the communities where development pressure is high. Major forces which can increase water demand in the planning area include the steadily increasing population outside the urban core and the rising standard of living.

An average of 329 million gallons (mgd) of water was supplied to the planning area each day in 1970. Estimated 1990 average day water demands for the entire planning area are 407 mgd. The major water supply system in the Boston area is the Metropolitan Water District, operated by the Metropolitan District Commission. Hereafter the system will be referred to as the MDC. The MDC is the largest regional system in New England, serving about two million people. Twenty-three of the most populated towns in the planning area are either wholly or partially served by this system and received a total of 262 mgd in 1970. The remainder of the water (67 mgd) was supplied, for the most part, by individual local ground water systems and surface water impoundments located within the planning area. Table 4.1 gives more details of this inventory.

Ground water supply is adequate for meeting the entire 1990 water demands of some communities in the Upper Charles River basin and in the outlying communities in the Neponset River basin. This source of supply will partially serve other communities in both basins, which will have to depend upon surface sources as well. In some areas, ground water is high in iron and manganese content which may limit its development. Moreover, development of some aquifers could lower stream and pond levels, thereby potentially reducing recreational values mentioned in Chapter 6. If ground water pumping is determined to significantly lower pond levels and streamflows, the municipalities should investigate other sources of supply.

The Solutions

Chapter 4 of the *Regional Report, Water Supply*, has discussed the relative costs of ground water, surface water, and regional water supply systems. Although ground water

is generally the most economical source of supply for local systems, regional systems offer economies of scale and organization. The size and efficiency of the MDC system place it at the lower end of the regional system cost scale. The wholesale cost of water from the MDC system is about \$200 per million gallons. In addition, municipalities must pay construction costs for the extension of MDC service to their towns. Where local ground water is unavailable or economically or environmentally unfeasible, supplies from the MDC may be an appropriate alternative. However, MDC supplies are limited, and in-basin ground and surface waters should be developed to the maximum extent environmentally, economically, and socially feasible (*Regional Report, Chapter 4, Water Supply*). Table 4.1 is a summary of the projected 1990 demands and the recommended sources of supply for each of the towns in the planning area.

A Major Regional System: The MDC

Because the MDC plays such a large role as a supplier of water in this planning area, and because municipalities in this area will require much of the MDC's future supply, it is appropriate to include a discussion of its future options in this report. Currently, the MDC supplies the water needs of 41 Massachusetts municipalities * (32 within the SENE region) from three major reservoirs: Quabbin, Wachusett, and Sudbury. These reservoirs impound water diverted from tributaries of the Connecticut and Merrimack River basins. Table 4.2 lists the municipalities served by the MDC as of 1970.

As in the case of other regional developments, the importation of water to municipalities in the Boston Metropolitan and Ipswich-North Shore planning areas (also partially served by MDC) has been primarily due to necessity. Where ground or surface water of sufficient quality and quantity is present, it should be developed. However, local development of ground and surface supplies in MDC towns is generally less satisfactory than importation of water, because of the lack of high quality supplies or the preemptive use of potential well sites, recharge areas, and watershed lands by urban and suburban development.

The existing dependable yield of the MDC system is estimated to be 300 mgd. However, the average daily

*Worcester also receives emergency supplies from the MDC. Lancaster has an agreement with the MDC to receive water, but has not made use of this agreement since 1963.

**TABLE 4.1 SUMMARY OF 1990 WATER SUPPLY PROPOSAL:
BOSTON METROPOLITAN PLANNING AREA**

Municipality	Source	Existing System (1970)	1990	1990	Proposed
		Safe Yield (mgd) ^{a,b/}	Average Demand (mgd)	Design Demand (mgd) ^{c/}	Additional Source of Supply
MYSTIC RIVER BASIN					
Arlington	MDC	6.8	8.26	Same	MDC
Belmont	MDC	2.6	3.09	Same	MDC
Chelsea	MDC	3.6	3.53	Same	MDC
Everett	MDC	8.0	9.28	Same	MDC
Malden	MDC	6.9	7.59	Same	MDC
Medford	MDC	8.1	9.22	Same	MDC
Melrose	MDC	3.0	3.49	Same	MDC
Somerville	MDC	10.7	11.31	Same	MDC
Stoneham	MDC	3.4	5.27	Same	MDC
Winchester	MDC	1.4	2.73	Same	MDC
Woburn	Wells	0.7			
	Wells	8.2	7.98	13.73	MDC
	Horn Pond	(2.4)			
CHARLES RIVER BASIN					
Bellingham	Wells	2.2	2.00	4.05	Ground water
Boston	MDC	141.7	152.60	Same	MDC
Brookline	MDC	7.4	8.86	Same	MDC
Cambridge	Hobbs Brook	13.7	24.45	Same	MDC
	Fresh Pond				
	Stony Brook				
	MDC				
Dedham	Wells	8.9			
		7.7 <u>d/</u>	3.24	6.19	Ground water & MDC
Dover	Wells	0.2	.36	.86	Ground water
Franklin	Wells	2.4	3.34	6.35	Ground water and Milford Water Co.
Holliston	Wells	1.9	1.99	4.03	Ground water
Lexington	MDC	4.5	6.42	Same	MDC
Lincoln	Wells	0.7	1.07	Same	None
	Sandy Pond	0.4			
Medfield	Wells	1.1	1.73	3.63	Ground water
Medway	Wells	1.8	1.60	3.30	Ground water & Milford Water Co.
Milford	Wells	0.4	3.19	Same	Milford Water Co. (Louisa Lake)
	Charles R.	1.0			
Millis	Wells	1.0	1.67	3.42	Ground water
Natick	Wells	9.2	10.27	16.94	MDC
Needham	Wells	3.4	5.19	Same	MDC
	MDC	1.0			
Newton	MDC	11.6	12.88	Same	MDC
Norfolk	Wrentham				
	State School	Unknown	.39	.92	Ground water
	Norfolk Cor- rectional Ins.				
Sherborn	Private Supplies	--	.27	.66	Ground water

Waltham	MDC	10.8	12.78	Same	MDC
Watertown	MDC	4.8	5.43	Same	MDC
Wellesley	Wells	7.7	4.82	8.82	MDC
Weston	Wells ^{e/}	2.1	3.31	Same	MDC
	MDC	0.4			
Wrentham	Wells	2.0	1.92	3.89	Ground water & Milford Water Co.
NEPONSET RIVER BASIN					
Canton	Wells	3.0	4.96	Same	Ground water & MDC
	MDC	1.0			
Milton	MDC	2.5	3.64	Same	MDC
Norwood	Wells	(3.0)	5.79	Same	Treated ground water
	MDC	3.0			
Quincy	MDC	10.2	12.44	Same	MDC
Sharon	Wells	3.7	2.48	4.90	Ground water
Stoughton	Wells	3.1	3.85	7.22	MDC
Walpole	Wells	3.5	5.95	10.59	Ground water & Willett Pond
					See Dedham
Westwood	See Dedham ^{d/}		2.41	4.76	
SOUTH SHORE					
Braintree	Great Pond Res. & Diversions	2.8	6.32	Same	Further develop Richardi Reservoir
	Richardi Res.	(3.0)			
	Tubular Well	(0.4)			
Hingham	Fulling Mill		3.29	Same	None
	Dug Well	2.2			
	Gravel-Packed Wells	3.9			
Holbrook	See Randolph		1.60	Same	See Randolph
Hull	See Hingham		2.51	Same	See Hingham
Randolph	Great Pond Res. & Diversions	1.3	4.37	Same	Further develop Richardi Reservoir
	Gravel-Packed Wells	2.5			
Weymouth	Great Pond & Diver- sions		6.09	Same	Treated Ground water
	Gravel- Packed Wells	4.5 (3.7)			

^{a/} All safe yield figures attributed to the MDC are estimates of the amounts provided in 1970 when the total demands on the MDC system approximated system safe yield.

^{b/} Ground water yield reported as pumping capacity of system. Standby supplies in parentheses.

^{c/} Systems relying primarily on ground water sources must supply maximum day demands.

^{d/} All safe yields for Dedham and Westwood are combined because they form one service area supplied by the Dedham Water Company.

^{e/} Weston is now entirely served by the MDC.

amount of water furnished by the system in 1970 was 307 mgd. Above average rates of precipitation since 1971 have enabled the MDC to supply more water than its theoretical safe yield. *

The existing deficit in the MDC's water supply must be corrected in the near future. In addition, the system will require new sources of supply as its member communities increase their consumption and as additional towns gain membership. In 1973, the *Northeastern United States Water Supply (NEWS) Study* by the U. S. Army Corps of Engineers estimated that by 1990 24 additional towns (18 of them within the SENE region) will have no option for water supply other than the MDC. These towns are listed on Table 4.3.** The Corps estimated that these towns and the 41 presently served towns will place an additional demand of 141 mgd (over its present 300 mgd yield) on the MDC by 1990. The Metropolitan Area Planning Council, in its report on *Alternative Regional Water Supply Systems for the Boston Metropolitan Area* by Camp, Dresser and McKee, February, 1971) came to a similar conclusion, estimating that the MDC would require 196 mgd yield by 1990.

In order to meet its projected demands, the NEWS Study recommended that the MDC undertake two water supply projects. Their recommended Northfield Mountain and Millers River basin projects would divert an average of 72 and 76 mgd, respectively, from the Connecticut River basin during periods of high flow.

The Northfield Mountain project would use a high flow skimming technique, principally during spring runoff periods, diverting water from the main stem of the Connecticut through Northeast Utilities' pumped storage hydroelectric facility in Northfield and Erving, Massachusetts. In order to provide water for the diversion, Northeast Utilities would pump an additional 375 million gallons into its upper storage reservoir each day that flows in the Connecticut are above a control flow of 17,000 cubic feet per second (cfs) at the Montague City U. S. Geological Survey gaging station. The diverted water would then be piped to Quabbin Reservoir through a 9.8 mile long aqueduct. Although high flow skimming of 375 mgd could yield an annual average of 84 mgd to the MDC system, the NEWS Study estimates that, because of "operational con-

TABLE 4.2 COMMUNITIES SERVED BY THE MDC IN 1970

FULLY SUPPLIED MEMBERS:

Arlington	Marblehead	Revere
Belmont	Medford	Saugus
Boston	Melrose	Somerville
Brookline	Milton	Stoneham
Chelsea	Nahant	Swampscott
Everett	Newton	Waltham
Lexington	Norwood	Watertown
Malden	Quincy	Winthrop

PARTIALLY SUPPLIED MEMBERS:

Cambridge	Peabody
Canton	Wakefield
Lynnfield	Weston
Needham	Winchester

NON-MEMBERS SUPPLIED:

Clinton	Leominster	Southborough
Chicopee	Marlborough	South Hadley, F.D. #1
Framingham	Northborough	Wilbraham ^{a/}
		Worcester ^{a/}

^{a/} On an emergency basis only

*Average daily amount of water supplied by the MDC in:

1971	=	322 mgd
1972	=	318 mgd
1973	=	316 mgd

**The MDC is now negotiating with two other municipalities not considered by the NEWS or SENE Studies. However, both studies found that these municipalities have alternative sources other than the MDC.

siderations," the average daily yield to Quabbin would be about 72 mgd.

Like the Northfield Mountain diversion, the Millers River basin project would use high flow skimming techniques to divert water from the East Branch of the Tully River, about four miles above Athol, Massachusetts, and from the main stem of the Millers River, about three miles above Athol. Both diversions in the Millers River basin would require not only the control flow of 17,000 cfs on the Connecticut at Montague City (see above), but would also require minimum flows on their respective rivers. Diversions might occur simultaneously or possibly only at one site, depending on the control flows and the water quality of the two rivers. Because of the low quality of the Millers River, treatment at the project's intake, or advanced treatment at the point pollution sources along the river, would be required. The combined diversion from the Tully and Millers Rivers would be carried to Quabbin through a seven mile long aqueduct and would provide the MDC with an average annual supply of 76 mgd. This amount, combined with the 72 mgd from the Northfield Mountain diversion, would provide 148 mgd to meet the NEWS Study's projected needs for MDC communities in 1990.

Findings of the SENE Study, however, indicate that reliance of the 65 towns on MDC supplies may not be as great as suggested by NEWS. Table 4.4 presents results of the NEWS and SENE Studies for comparison. The SENE Study findings are based on two factors which differ from those of the NEWS analysis: lower population projections and a different interpretation of existing and potential local resources available to meet water needs.

Both the NEWS and SENE Studies estimate a reasonably close rate of increase in domestic per capita water consumption between 1970 and 1990. However, while the NEWS Study used the OBERS "Series C" figures as the basis for its population projections, the SENE Study has used a more recent set of figures, the OBERS "Series E" projections. The latter projections assume a continuation of the zero population birth rate level which the nation is now experiencing, rather than the higher 1960-1970 national growth rate on which the "Series C" projections are based.* Although the disaggregated figures may not be totally accurate for individual towns and cities, it is felt that over the total number of municipalities considered in this comparison, the Series E figures are reasonable projections.

The second major difference between the SENE and NEWS figures is the evaluation of sources other than the MDC. Based on its policy of maximum use of local resources, the SENE Study has investigated the existing or potential local surface and ground water sources for the same 65 municipalities evaluated by the NEWS Study. Detailed accounts of the SENE Study's findings for the communities within the SENE region may be found in the *Regional Report* and *Ipswich North Shore Planning Area Report*.

Although the SENE Study was able to identify 12 mgd in potential additional local resources in the 65 communities, this figure is not significantly different from the 9 mgd which the NEWS Study identified as additional supplies. Thus, the major difference in the two studies' water supply figures is 30 mgd in the estimated yield of existing local supplies. This difference may be explained by the fact that the NEWS Study significantly reduced its estimate of the amount of existing ground water

TABLE 4.3 THE 24 COMMUNITIES WITH NO REPORTED OPTION OTHER THAN THE MDC (NEWS STUDY)

*Ashland	*Hudson	Sherborn
Avon	Lincoln	*Stoughton
Bolton	*Maynard	Stow
Braintree	Medfield	Sudbury
*Dedham	Millis	*Wellesley
Dover	*Natick	*Westwood
Holbrook	Norfolk	Weymouth
Holliston	Randolph	*Woburn

* The nine (9) communities which the SENE Study finds have no reported option other than the MDC.

*In fact, the OBERS Series E figures closely approximate the "Dispersed" estimates (or the lower limit) of county population totals listed in the NEWS Study [Millers River Basin Water Supply Project, Volume II, Appendix B, pp. B-13 to B-14].

supplies if these supplies were insufficient to meet maximum day demands. In contrast, the SENE Study included all ground water supplies which satisfied communities' average day demands,* provided that these communities also had storage of additional supplies sufficient to meet their maximum day demands.*

Therefore, of the 24 additional communities which the NEWS Study assigned to the MDC service area by 1990, the SENE Study has found that only 9 would have to join the MDC at that time (see Table 4.3). The remaining 15 municipalities appear to have a sufficient amount of water from existing or potential local sources to postpone their membership in the MDC system. If more detailed investigations of local resource potential reveal that additional supplies are not available or suitable for use, the affected municipalities will require connection to the MDC.

The last row of figures on Table 4.4 compares the NEWS and SENE Study estimates of MDC communities' needs for water by 1990 if no additional sources of water supply were developed (ie, if neither the Northfield Mountain nor the Millers River basin diversions were constructed). While the NEWS Study estimates that 141 mgd would be required by 1990, the SENE Study figures indicate that, based on lower demand projections and on maximum use of local resources, only 77 mgd would be necessary to meet the MDC communities' needs. The question faced by the MDC is how these short-range needs will be met.

The SENE Study has investigated short-range water supply alternatives to the Northfield and Millers Rivers diversions, but to date has been unable to suggest any alternatives which, either separately or in combination, are demonstrably superior to these projects. However, work is in progress on

TABLE 4.4 COMPARISON OF NEWS AND SENE STUDY ESTIMATES FOR WATER SUPPLIES IN METROPOLITAN BOSTON THROUGH 1990 WITHOUT NORTHFIELD MOUNTAIN AND MILLERS RIVER DIVERSIONS. ^{a/}

<u>Assumptions – DEMAND</u>	<u>NEWS</u>	<u>SENE</u>
Rate of growth, per capita use	1.1 gpcd/yr ^{b/}	1.1% pc/yr ^{c/}
Total projected population 1990	2,845,000	2,773,000
Total projected demand 1990	524 mgd ^{d/}	493 mgd
<u>Assumptions – SUPPLY (in mgd)</u>		
Existing MDC supply	300	300
Existing local supply	74 ^{e/}	104 ^{f/}
Potential local supply	9	12
Total projected supply – 1990 without additional diversions	383	416
Net deficit – 1990	141	77

^{a/} Service area: Current MDC towns (fully and partially supplied (32), current non-member towns supplied (9), and towns identified by NEWS as having no reported options other than MDC service by 1990 (24).

^{b/} gallons per capita per day/year graphical; domestic rate (industrial rate not available)

^{c/} per capita/year compounded; domestic and industrial rate

^{d/} total NEWS demand based on domestic and industrial projections

^{e/} 1970 yield of ground water systems reduced to allow for 1970 maximum day demands

^{f/} 1970 yield of ground water systems applied to 1990 average day demands
Additional supplies available to meet 1990 maximum day demands.

*Average day demands represent a community's yearly average of daily water demands. Maximum day demands represent the amount of water required by a community on the peak day in any given year. Because ground water supplies generally have no storage facilities, communities which rely entirely on ground water must develop enough supplies to meet their maximum day demands even though these peak demands may occur infrequently. However, the SENE Study finds that communities which use both surface and ground water supplies can rely on the storage capacity of their reservoirs to provide the additional water needed to meet maximum day demands. Thus, these communities only need to develop ground water supplies to meet their average day demands.

several studies, and additional investigation needs to be carried out in order to determine their feasibility.

The Merrimack River presently serves as a source of water supply for Lawrence, Lowell, and Methuen, and could, with treatment, serve communities in the Ipswich and Merrimack basins which now are members of the MDC or which might have to join the MDC in the future. The NEWS Study is presently considering the advisability of providing supplies to several Merrimack valley communities from the Merrimack by 1990. However, the NEWS Study is not considering diversions from the Merrimack to serve out of basin needs, including those of the MDC, until after 1990. Presently, the water quality of the Merrimack River necessitates a high degree of treatment before it can be used as a water supply source. The cost of treatment and distribution, which could result in a total project cost as high as \$79.1 million for in-basin use alone,* precludes this alternative as a practical short-term solution for MDC needs. State and local interests in New Hampshire are also concerned about the potential Massachusetts diversions of the Merrimack. Nevertheless, it appears that a clean Merrimack River will hold the greatest potential as a long-term solution for the MDC's water supply problems, and continuing study of this alternative is extremely important.

The MDC is currently sponsoring a study on the feasibility of using the Upper Sudbury River as a source of additional water supplies. A draft report has been prepared and is undergoing review by the MDC, but no conclusive information has been developed as yet. However, there is a possibility that if technical matters are resolved, the Upper Sudbury could provide the MDC with additional supplies of between 30 and 40 mgd by the mid-1980's. These supplies would be in addition to the 15 mgd presently being withdrawn from the Sudbury River for MDC use. Until more definitive information is developed, neither the MDC nor the SENE Study can evaluate the feasibility of the Upper Sudbury project, but it appears to be a potentially valuable source of supply, and the Study endorses the MDC's continued investigations.

The apparently substantial reserves of ground water in Plymouth County, Massachusetts, have been suggested as an alternative source to the Northfield Mountain and the Millers River diversions. However, as discussed in the South Shore Planning Area Report, the South Shore is one of the fastest growing areas in the Southeastern New England region. Based on discussions with consultants who are conducting a water supply study in the area, the SENE Study's conclusion is that Plymouth County ground water will be needed to meet local, in-basin water supply needs.

This source may be a short-term solution, helping to keep several South Shore communities from having to join the MDC, but, in the long run, it will probably not be possible to supply the MDC area with enough Plymouth County ground water to reduce the need for additional sources.

Desalination has been proposed as a source of additional MDC water supplies. However, as mentioned earlier in this chapter, present desalination techniques are not economically feasible for large-scale use, and environmental problems, such as brine disposal, still remain to be solved. Desalination will certainly not be economically feasible in time to preclude the need for the Northfield Mountain diversion, and it is doubtful that it could be developed in time, and at a large enough scale, to replace the Millers River diversion. It is important to note, however, that desalination has a great deal of potential as a long-term source of water supply, and studies on the development of economically feasible, environmentally safe methods of desalination should be vigorously pursued.

The reuse of wastewater has also been discussed in a previous section of this chapter. The SENE Study has concluded that while recycling of wastewater for industrial use can be economically sound, it will probably be many years before recycled wastewater is an economically viable alternative to other sources of drinking water supply. Industrial recycling of water would not result in large enough savings to negate the short-term needs for new MDC sources. However, in the long term, wastewater reuse for drinking water and for industrial use could result in substantial water supply savings and research in this field must be continued.

Another alternative which should be explored is the reactivation of presently unused local water supplies in communities now served by the MDC. Although the SENE Study staff is aware of no previous work on this matter, it is possible that if local supplies were reactivated, pressures on the MDC sources would be lessened. This proposal is consistent with the Study's theme of making maximum use of local resources. Unfortunately, reactivation may not be an economically acceptable solution for many of the communities involved, which joined the MDC because of the high costs of treating their local supplies. However, communities such as Canton, which joined the MDC because of demands on local wells during the summer months, can maintain local sources to meet most of their needs, while relying on the MDC for augmenting their water supplies during times of peak demands. Other communities which have discontinued the use of previously significant supplies should look into the option of their reactivation to lessen the burden placed

*MERRIMACK RIVER WATER SUPPLY STUDY. Information Packet for Pub. Meeting, July, 1975.

on MDC sources. Additional research would have to be carried out to determine the technical feasibility and the costs and benefits of reactivating local supplies.

Continuing the theme of maximizing the use of in-basin water supplies, the SENE Study strongly endorses the MDC's present policy of requiring maintenance and development of its member communities' local resources. The Study encourages the MDC to continue this policy, even as additional sources become available. Communities which, in the past, were required to purchase a certain percentage of their water from the MDC in order to be served should consider revising their agreements with the MDC if they can make greater use of their local resources and place fewer demands on the MDC. The maintenance and protection of existing in-basin water supplies, as well as the protection of potential local sources, remains the major recommendation of the SENE Study.

Water conservation must also be stressed in the MDC communities. Water-saving appliances and fixtures discussed earlier in the chapter could result in stabilized or reduced water demands if they were used on a large enough scale. Unfortunately, it does not appear that this approach can be regarded as a short-term solution to the MDC's water supply problems, as it should require a significant period of time to replace older appliances. In terms of future savings however, a greater emphasis on water-saving devices could increase public awareness of their benefits. The Study has also suggested, above, that these fixtures could be required in new buildings when their cost is less than the price of the water they would save. Certainly, a program of public education on the advantages of water conservation would be a first step towards voluntary "demand management."

Along the same lines, the MDC must act to prevent water losses from system leakage. A recent study*, prepared for the MDC by the Water Resources Research Center at the University of Massachusetts and Curran Associates, Inc., has identified a large amount of "unmetered" water usage in MDC communities, particularly in Boston.

"Unmetered usage" includes distribution system leaks, unavoidable leakage, meter slippage, "blow-offs" (devices to prevent freezing water pipes or poor water quality), main flushing, sewer flushing, street cleaning, fire fighting, unmetered public usage, and other unmetered usage. Because the unmetered usage in Boston accounts for over half of the total unmetered usage in all MDC communities, the Water Resources Research Center report recommends that the city undertake a study to investigate the causes of this situation. The report also states that leaks and breaks in many water distribution systems are generally regarded as the major component of unmetered usage (p. 57). Even though some leakage in a distribution system is unavoidable, the report suggests that,

"based on the price of water in the MDC communities, location and repair of leakage in excess of 3,000 gallons per mile of main per day may be considered justifiable" (p. 58). If a large portion of the MDC's unmetered water use is, in fact, leakage, and if all communities served by the MDC could eliminate leakage in excess of 3,000 gallons/mile of main/day, the report estimates that approximately 48 mgd of the communities' total 1972 demand of 376 mgd could be saved. Since a large proportion of this water is supplied by the MDC (about 318 mgd in 1972), the 47 mgd reduction could result in substantial water savings for the system. It is therefore in the best interests of the MDC and the City of Boston to pursue the Water Resources Research Center's investigations further and, if their findings are confirmed, to act immediately to reduce water loss from system leakage.

In light of the foregoing discussions, it appears that while several water supply alternatives may be potentially important to the MDC's future supplies, and while water conservation measures can result in significant savings, neither the above individual alternatives nor a combination of them has the potential to fully meet the MDC's projected short-range water supply needs of 77 mgd. In contrast, the proposed Northfield Mountain project would supply the MDC's water needs through the late 1980's.

It appears that the water supplies from the Northfield Mountain diversion will be required to meet the needs of MDC communities almost immediately. The diversion, which has been approved by the Massachusetts legislature, would provide the MDC with 72 mgd from the Connecticut main stem. Subject to pending negotiations, the project would use the existing Northfield pumped storage facility operated by Northeast Utilities. The 1980 Connecticut River Basin Plan, prepared by the New England River Basins Commission in 1972, investigated the diversion from the "donor" area's point of view. Recognizing the need for environmental safeguards and the potential political problems which could arise, the Plan recommended the Northfield Mountain diversion, *with the following qualifications:*

1. "The Commission recommends continued evaluation for adverse environmental effects throughout project planning, development and operation, with mitigation of environmental damage or repair by removal of the cause.
2. "The Commission recommends that all proposed diversions of Connecticut River water below the newly constructed nuclear power plant at Vernon, Vermont, including Northfield Mountain, be conditioned on satisfactory completion of environmental impact evaluations of the power plant. It is recommended that these evaluations include careful investigations

*Water Usage Study in Communities served by the Metropolitan District Commission. June, 1975.

of the possibility of radioactive contamination of Connecticut River water into Quabbin reservoir. It is further recommended that proposed diversions be conditioned on adequate measures to prevent radioactive contamination of diverted water, including water quality monitoring.

3. "Diversion of surplus water from the Basin is recommended subject to recognition of riparian rights, specifically the right of return of these waters when needed for water supply or flow augmentation within the basin.
4. "The Commission recommends [that]..... approval of diversions [in addition to that already authorized at Northfield Mountain] be conditioned on:
 - a. Creation of a regional mechanism for allocating water in which downstream states have a voice. In the event that the creation of such a mechanism proves unfeasible, it is recommended that its functions be performed by existing institutions with appropriate regional management capabilities;
 - b. Prior measurement of the impacts — environmental, social, public health, economic, and other — used in determining "excess flows" [that is to say: prior determination of the impacts the diversion(s) would have]; and,
 - c. Prior determination of the location and available yield of ground water sources in the [Connecticut] basin and on development of adequate measures for their protection, in coordination with environmental and flood management studies conducted as part of the supplemental study program."

The first condition, that of continued evaluation for adverse environmental effects, has been addressed in part by the Corps of Engineers in their environmental studies of the Northfield Mountain and Millers River basin diversions. The Corps has also stated that during post-authorization studies, environmental analysis will continue until action on the projects is complete. Moreover, departments in the Massachusetts Executive Office of Environmental Affairs and the Office of State Planning will have the opportunity to review the environmental effects of the projects during the state's evaluation of their environmental impact reports. It should be noted that completion of the Northfield project is subject to compliance with both the Massachusetts Environmental Policy Act and the National Environmental Policy Act. In addition, it is also important that environmental impact be

considered after the diversions are in operation and that any adverse effects of the projects be remedied.

Steps are being taken to satisfy the second condition, that of water quality monitoring below the Vernon, Vermont nuclear power plant. The completion of the Atomic Energy Commission's Impact Statement on the Vermont Yankee plant indicates that public health agencies and detailed monitoring specifications should effectively guard against water quality problems. In addition, the U. S. Environmental Protection Agency (EPA) has advanced the opinion that this diversion would not cause degraded water quality in MDC supplies, provided that the EPA-proposed program of watershed management to maintain Class B water in the vicinity of the water intake at Northfield is carried out*. However, final authority to approve or disapprove of the Northfield project on water quality criteria is the responsibility of the Commonwealth of Massachusetts.

The third condition, recognition of riparian rights, has not yet been resolved by the parties involved, primarily the states of Connecticut and Massachusetts. It may be appropriate to deal with this issue in the context of developing a regional mechanism for the equitable allocation of the Connecticut River Basin's water supplies.

The 1980 Basin Plan's final condition, which includes the above-mentioned regional mechanism, deals with diversions beyond the Northfield Mountain project and will be discussed in detail with respect to the Millers River diversion, below.

Whereas the 1980 Connecticut River Basin Plan has documented the issues of environmental safeguards and political equity required by the "donor" region before the Northfield Mountain diversion can be constructed, the SENE Study's figures have substantiated the need for the diversion from the "recipient" area's perspective. Therefore, while observing the qualifications listed above, it is the SENE Study's position that the Northfield Mountain diversion should have first priority for the MDC.

According to the SENE Study's estimates, the completion of the Northfield Mountain project would leave the MDC communities with a 1990 deficit of 5 mgd. Although this amount of water would have to be provided, the figure does not carry the urgency of the 69 mgd deficit projected by the NEWS Study for this same date. In other words, the findings of the SENE Study suggest that although the Northfield Mountain diversion will be needed as soon as possible to meet the MDC's water supply demands, the need for additional supplies will not occur until the late 1980's. However, at that time several municipalities which will have been able to rely on local sources may

*Correspondence from Regional Administrator, EPA Region I to Division Engineer, New England Division, Corps of Engineers, February 28, 1975.

have to look to the MDC for supplementary supplies, even if they protect and conserve their existing and potential supplies. In addition, the rate of water consumption in the 50 municipalities which will require MDC service will continue to increase, though probably at a lower rate than at present.

If the rate of increase of per capita water use remains at about one percent (1%) per year, MDC municipalities would require an additional 196 mgd over the MDC's current safe yield of 300 mgd by 2020 — far more than the two proposed diversions could supply. For reasons given earlier in this chapter, however, it appears more likely that the rate of increase in water use will slow down in the future. If this rate is assumed to be a 0.5 percent increase per capita per year after 1990, the SENE Study estimates that the 50 municipalities which it recommends be assigned to the MDC will require an additional 117 mgd by 2020 rather than 196 mgd.

As the previous discussion of short-term alternatives has shown, the Millers River diversion currently represents the most reliable source of the additional supplies which will be required in the late 1980's. However, water supply alternatives such as the Upper Sudbury River and conservation measures may lessen the pressure which the MDC communities will place on their water resources. With the Millers River basin project in place, and based on the lower 0.5 percent increase in per capita usage per year, the SENE Study estimates that the 76 mgd which the project would supply could meet the MDC's additional water needs through 2020. In fact, if the lower rate of growth in water use discussed above were to occur, about 31 mgd would be available to meet the additional water requirements of the municipalities which would have to join the MDC between 1990 and 2020.

However, before the Millers River diversion can be constructed, it is extremely important that the final set of conditions, listed above under the 1980 Connecticut River Basin Plan's fourth recommendation, be observed.

The development of a regional mechanism, if feasible, or other appropriate arrangement, between Connecticut and Massachusetts in order to allow downstream interests a voice in water supply allocation is a recommended condition for development of the Millers River diversion as indicated on page 4—8. Unfortunately, despite meetings held in 1974, the two states have been unable to reach an agreement on the form this mechanism should take. The New England Division of the Army Corps of Engineers recommended that federal loans for both the Northfield

Mountain and Millers River basin projects be conditioned upon prior agreements between Massachusetts and Connecticut on the diversion issues. However, reports of the Corps of Engineers' Board of Engineers for Rivers and Harbors have stated that, while it will be in the best interests of both Connecticut and Massachusetts to "enter an agreement regarding the management and allocation of waters of the lower Connecticut River"* , it is not necessary to make this agreement a condition for federal loans in the case of the Northfield Mountain or Millers River basin projects.

The Water Resources Research Center has recently been funded to study the question of an interstate water allocation mechanism for the Connecticut River. It is hoped that the recommendations of this Study will encourage Connecticut and Massachusetts to reach a mutually acceptable agreement and will provide the states with the tools to do so.

The second prerequisite (page 4 — 8) before a diversion such as the Millers River basin project could be recommended is that there be prior measurement of the diversion's environmental impacts on the "donor" area. The NEWS Study has included detailed environmental reports on the impacts of the Millers River diversion. The Board of Engineers for Rivers and Harbors found that these reports were of sufficient scope and depth to support the project recommendations. It also concluded that the positive effects of the diversion would outweigh its minor adverse environmental effects. However, residents of the Connecticut River basin have felt that it is necessary to have more detailed information than has been currently produced, in order to fully evaluate the environmental effects of the project. In addition, Connecticut River basin interests have requested reevaluation of the present control flow requirement of 17,000 cubic feet per second (cfs) at Montague City to determine the appropriateness of that figure.

Water quality monitoring, a prerequisite for the Northfield Mountain diversion under the 1980 Connecticut River Basin Plan, should also be a major consideration for the Millers River diversion. EPA has stated that its approval of the diversion of water from the Millers River is not possible until the point sources of pollution on the river have been treated and good quality water is consistently available.** The Corps of Engineers' Board of Engineers for Rivers and Harbors has also expressed the opinion that in addition to monitoring the water supplies, additional studies should be conducted to more precisely define the scope of the Millers River diversion's water quality problems and ecological effects. Two years ago, the Massachusetts Water Resources

*DAEN-BR (21 March 1975) (25 Oct. 74), 2d Ind, Subject: Northfield Mt. Water Supply Project Survey; Millers River Water Supply Project, Survey .

**Correspondence from Regional Administrator, EPA Region I to Chief Engineer, New England Division, Corps of Engineers, December 24, 1974.

Commission indicated a willingness to prepare a mathematical water quality model of the Millers River as a part of the development of a complete plan for that basin. Information from such a model would provide data useful for impact assessment of the diversion of Millers River water to the Quabbin Reservoir.

Currently, the Federal Power Commission, under a separate study, is preparing an environmental impact statement on the relationships among hydroelectric facilities, the electric power generation and transmission systems, and water use in the Connecticut River basin, with extensive use of mathematical models. This material should prove useful in further determining the environmental effects of diversions in the basin.

The findings of the SENE Study indicate that there is time for additional research on the above issues before the Millers River basin project is needed. While the option to divert water from the Millers River basin should be protected by beginning the initial project planning and acquiring the necessary land, this additional time can be used to provide more definitive information on alternatives to the diversion and its environmental consequences. In addition, the Corps of Engineers has stated that its environmental analysis will continue during post authorization studies.

A third condition (page 4-8) which must be met before the Millers River diversion can be implemented is the prior determination of the adequacy of water resources in the Connecticut River basin. The in-basin water supply needs have been considered both within the earlier Connecticut River Coordinating Committee report* and also by the Corps of Engineers during the NEWS survey. Water supply needs were considered beyond 2020, and both groups found that the size of the in-basin need was extremely small in comparison with the amount of water that would be left within the river after diversion. Further, during the environmental and ecological investigations of the basin conducted for the NEWS Study, and during the continuing ecological studies of the Connecticut River Supplemental Study, no in-basin needs which would be adversely affected by the diversion were determined.

However, members of the 1980 Connecticut River Basin Plan's Citizens Review Committee were concerned about the adequacy of Connecticut Basin ground water resources to meet future needs. It was felt that the future water requirements of the basin, including the needs of municipalities, industries, and agriculture along the Connecticut River and its tributaries, must be considered in estab-

lishing a policy on out-of-basin transfers. The group's objective, given the current data base, would be to obtain a reasonable understanding of in-basin needs before allocations of water could be made.

Based upon the foregoing discussions, the SENE Study has determined that the Millers River diversion can be recommended assuming that the conditions of the 1980 Basin Plan are observed. If they are not satisfied, other alternatives may have to be selected, despite their present environmental or economic implications.

In conclusion, the SENE Study has confirmed the MDC's need for the Northfield Mountain diversion. Moreover, it appears that the Millers River Basin project will be required by 1990 because no currently proven short-range alternatives will fully meet the MDC's water supply needs. The supplies provided by the Millers River basin diversion can be expected to meet the MDC's additional water requirements through 2020. This is a significant finding. Based on its assumptions of population growth and water use, the SENE Study has shown that the supplies of the Millers River project will be adequate for a longer period than previously believed.

Of course, population and consumption projections are always open to question, especially when they are long-range estimates. The growth of water supply demands in the MDC service area should be monitored so that the MDC can update its projections of future water demands and can plan for serving them. However, assuming the accuracy of the SENE Study's water consumption projections, this more optimistic picture means that the conditions affecting the environmental and political consequences of the Millers River basin diversion can be clarified before construction of the project begins.

The Secretary of Environmental Affairs for Massachusetts has stated that the timing and economics of water supply alternatives to diversions must be addressed before it is assumed that further diversions are necessary and wise.** As discussed above, the SENE Study indicates that there is additional time for consideration of these alternatives, at least as they apply to the Millers River diversion. At the same time, however, the option to build the Millers River project must be kept open. This can be accomplished by initiating planning and design of the project and by acquiring the land necessary for its construction. In the meantime, work must continue on the long-range water supply solutions which do not involve further diversions of the Connecticut River. The longer the MDC can rely on

*Connecticut River Basin Coordinating Committee, Comprehensive Water and Related Land Resources Investigation Connecticut River Basin, Volume III, June 1970.

**Correspondence from Secretary of Environmental Affairs, Commonwealth of Massachusetts, to Chairman, New England River Basins Commission, September, 1975.

the Northfield and Millers River basin projects for its additional needs, the more time is allowed for the development of advanced technologies and new resources in South-eastern New England.

The Millers River basin project can be expected to meet the MDC's needs through 2020. In the interim, it is likely that alternatives such as diversions from the Upper Sudbury or Merrimack Rivers, recycling, and desalination will become technically, economically, and environmentally feasible as major sources of water supply, and that they will be developed when new sources are needed. Constructive use must be made of the years before 2020, ensuring that all long-range solutions are thoroughly investigated from economic, environmental, and social perspectives.

1. **Expand MDC sources by constructing the Northfield Mountain Facility.** Carry out conservation measures. Plan the Millers River Facility. To meet immediate needs, the Metropolitan District Commission should promptly construct the Northfield Mountain diversion facility. The MDC should actively carry out conservation measures and should encourage investigation of unmetered water use problems. The Millers River basin project does not have to be in operation until the late 1980's, but to protect the opportunity for timely implementation of this option, design and land acquisition should be initiated now. In addition, the MDC should continue to examine the technical, economic, and environmental feasibility and timing of other alternatives for meeting its long range needs.

In carrying out this recommendation, the affected states and, specifically the Massachusetts Executive Office of Environmental Affairs and the Corps of Engineers can continue to implement the provisions of the NERBC 1980 Connecticut River Basin Plan, which recommends continual evaluation for adverse environmental effects throughout project planning, development and operation, with mitigation of environmental damage or repair by removal of the cause. In addition:

For the Northfield Mountain Facility as well as subsequent diversions, the 1980 Basin Plan recommends that:

- based on satisfactory completion of environmental impact evaluation, proposed diversions be conditioned on adequate measures to prevent radioactive contamination of diverted water, including water quality monitoring; and,
- diversion of surplus water from the Connecticut Basin be subject to recognition of riparian rights, specifically the right of return of these waters when needed for water supply or for flow augmentation within the basin.

Before any diversions in addition to that already authorized at Northfield Mountain are made (i.e. the Millers River diversion), the Basin Plan recommends that:

- an appropriate mechanism be established for allocating water in which downstream states have a voice. In the event that the creation of such a mechanism proves unfeasible, it is recommended that its functions be performed by existing institutions with appropriate regional management capabilities.
- prior evaluation of environmental, social, public health, economic, and other impacts on in-basin needs be made;
- monitoring the quality of water continue; and,
- Connecticut River Valley in-basin ground water resources be determined and adequate measures for their protection be developed.

In five years, the MDC should also re-examine population growth and consumption needs to verify trends and determine the necessary timing of needed solutions; and should:

- continue to require maintenance and development of member community local resources;
- actively promote water conservation measures, including use of water saving devices and demand management; and,
- take steps to prevent economically avoidable water losses from distribution system.

If the provisions of the 1980 Connecticut River Basin Plan, summarized above, are not satisfied, other alternatives may have to be selected. At the present time, alternatives being studied include:

- the feasibility of diversion of treated Merrimack River and/or Upper Sudbury River waters to the MDC system as additional sources; and,
- new technologies including waste water recycling and desalination.

Mystic River Basin

The municipalities within the Mystic River basin, with the exception of Winchester and Woburn, are served entirely by the Metropolitan District Commission (MDC). They are: Arlington, Belmont, Chelsea, Everett, Malden, Medford, Melrose, Somerville, and Stoneham. Winchester depends on the MDC system for nearly 70 percent of its demand, with a local ground water supply providing the remaining amount. Woburn has been meeting its own needs through ground water from local wells. However, the MDC has entered into an agreement with Woburn to provide a minimum of one third of its demand up to 13 mgd. This agreement has stipulated that Woburn must keep most, or all, of its municipal wells. Private industrial use in the basin amounted to about 7 mgd supplied by ground water. This demand was generated primarily in Woburn. By 1990, it appears likely that all eleven communities will be supplied by the MDC system. Winchester, which now utilizes some local ground water sources, will depend upon the MDC for the increased demands projected for

the future. Woburn has an estimated safe yield that approaches its 1990 projected demand. Ground water quality problems will probably result in a lowering of the available yield for public supply.

In the lower Mystic basin town of Everett, a ground water reservoir exists with the potential to satisfy industrial water needs. Infiltration of brackish or salt water from the Mystic River estuary below the Amelia Earhart Dam can be expected in wells tapped in this area if they are drawn down below mean sea level for extended periods.

The SENE Study recommendation is as follows:

2. **Protect ground water sources in Everett and Woburn.** Everett and Woburn should take the necessary steps (*i.e. zoning as discussed in Chapter 3*) to protect aquifers used for water supply through prohibition of land uses hazardous to ground water quality.

Charles River Basin

Within the Charles River basin, the water demands of seven communities — Boston, Brookline, Lexington, Newton, Waltham, Watertown, and Weston — are fully supplied by the MDC. Two additional communities rely to some extent on the MDC system to supplement existing sources: Cambridge (surface water) and Needham (surface and ground water). Although Weston was previously able to rely entirely upon its own ground water supplies, the application of highway de-icing salt at the interchange of Route 128 and the Massachusetts Turnpike has contaminated one of the town's wells. Weston has therefore had to turn to the MDC. This is the type of situation that must be avoided in the future; towns relying on ground water must protect their sources from harmful contaminants (*Chapters 3 and 4, Regional Report*). The Department of Transportation, the Massachusetts Department of Public Works, and water supply planners have to work together to coordinate their activities in order to prevent situations such as that in Weston from arising.

The remaining communities in the basin rely on local sources of supply. All but one town (Lincoln) in the Charles River basin will have to increase their current supplies to meet projected 1990 demands. The increased water demands expected by 1990 for all nine MDC member communities will be most economically supplied by the MDC sources. By 1990, it appears that Wellesley and Natick will have to find additional sources of supply, and further development of ground water sources does not appear a viable alternative. Such development would result in depletion of streamflows and reduction of pond and lake levels in the area, which would have harmful environmental effects. These towns are expected to seek service from the MDC system, which would have to be extended to the area in order to supplement existing local sources in each community. One other

town in the planning area that should explore an arrangement with the MDC for additional supply is Dedham. The Dedham Water Company, serving Dedham and Westwood, does not appear to have sufficient developed sources to meet anticipated 1990 maximum day demands. If further ground water development is not successful, the company should look to the MDC to supplement its existing local sources of supply. Accordingly:

3. **Extend MDC service to supplement sources in Wellesley, Natick, and Dedham.** All municipalities currently dependent on the MDC in the Charles River basin should continue to rely on this system. Wellesley, Natick, and Dedham should enter into agreement with the MDC for the purpose of supplementing their existing local sources.

In the Upper Charles region, seven communities — Bellingham, Dover, Holliston, Medfield, Millis, Norfolk, and Sherborn — appear to have sufficient ground water potential to supply their needs through 1990. Treatment for iron and manganese may be necessary, particularly in the town of Holliston. Franklin and Wrentham, however, using aquifers which recharge from small watershed areas, are unlikely to be able to meet peak demands from local ground sources without seriously depleting streamflows and lowering pond and lake levels. Medway, too, may be unable to fully supply projected maximum day demands from local aquifers.

One proposal considered by the SENE Study called for Franklin, Wrentham, and Medway to join with Milford in expanding that town's Echo Lake source by increasing its storage capacity, diverting water from Louisa Lake, and constructing a treatment facility. Further investigation of this opportunity has indicated, however, that these actions will provide only enough additional capacity to meet Milford's projected water needs for 1990.

Also evaluated was the potential for developing a water supply reservoir on Mine Brook in Franklin to serve Franklin, Medway, and Wrentham. This site, however, has been designated by the U. S. Army Corps of Engineers as a natural valley flood storage area, effectively precluding its use for water supply. Even if construction of a shallow reservoir were possible on Mine Brook, serious water quality problems would probably result.

A third alternative would be extension of the MDC system to the area. However, the MDC is currently supplying water at a deficit (see above discussion) and will not have the required additional sources to develop service in this area for some time. It would be unwise for the MDC to extend its services to new municipalities outside its required service area (within a 15 mile radius of the State House) while its

existing sources are overtaxed.

The SENE Study recommendations are as follows:

4. **Expand the capacity of Echo Lake to serve Milford.** Milford should begin now to increase the storage capacity of Echo Lake by raising the existing dam, diverting additional supplies from Louisa Lake, and constructing a water treatment facility.
5. **Develop ground water sources to serve Franklin, Medway, and Wrentham.** These towns should fully explore and carefully develop their remaining ground water resources. Water conservation measures should be enacted immediately and recharge of treated wastewater thoroughly explored in order to prevent future overpumping of the underlying aquifers.
6. **Develop ground water supplies in other Upper Charles municipalities.** The municipalities of Bellingham, Dover, Holliston, Medfield, Millis, Norfolk, and Sherborn should develop additional local ground water supplies, which should be sufficient to meet the municipalities projected 1990 needs. These municipalities, many of which are increasingly under pressure for development, should undertake methods for protecting these resources described in Chapter 3 of this report and in Chapter 4 of the Regional Report.

Neponset River Basin

In the Neponset River basin, four communities receive some portion of their water supply from the MDC. Milton and Quincy receive full supply. A very small portion of Norwood's demand is supplied by local ground water, with 99 percent supplied by the MDC system. Canton also uses local ground water for a portion of its supply, with the MDC providing the remainder. All four towns will continue to depend on the MDC system to meet their 1990 needs. In addition, Canton and Norwood should use existing and potential ground water resources to the maximum judicious extent. Therefore:

7. **Maintain and upgrade ground water sources in Canton and Norwood.** Canton and Norwood should develop additional ground water resources in addition to continued MDC service in order to minimize the cost of future water supply.

Sharon, Stoughton, Walpole, and Westwood are presently all supplied from local ground water sources. Sharon appears to have sufficient potential for meeting its 1990 needs with additional ground water development in the town. Stoughton, which is presently operating under water use restrictions, will have to look outside the community for additional sources of supply. Even though Stoughton is located outside the MDC's required service district, its need is so great that obtaining MDC supplies appears to be the most acceptable alternative the town has.

Ground water development potential in Walpole is insufficient to supply 1990 maximum day demands projected for the town. In order to supplement existing supplies by that time, Willett Pond should be developed and treated for water supply use.*

Westwood, served with Dedham by the Dedham Water Company, must also seek to supplement local ground sources in order to meet anticipated 1990 peak demands. Extension of MDC service to these towns is the most logical source of additional supply.

For the above towns, the SENE Study makes the following recommendations:

8. **Develop ground water sources in Sharon to meet 1990 needs.** Sharon should develop additional ground water sources to meet 1990 needs.
9. **Develop Willett Pond in Walpole for supplementary supplies.** Walpole should develop Willett Pond to supplement its existing supplies.
10. **Extend MDC service to Westwood and Stoughton.** MDC service should be extended to Westwood and to Stoughton. Current water supply shortages in Stoughton and the availability of feasibility data make an extension to this municipality a top priority.

South Shore Towns

Limited opportunities exist in the south coastal area of the Boston Metropolitan planning area to develop additional surface and ground water resources. Hingham and Hull, both served by the Hingham Water Company, should be able to supply projected water demands from existing ground and surface sources. Braintree, Holbrook, and Randolph, all presently served from Great Pond Reservoir, have an option to increase diversions from the existing Richardi Reservoir

*Camp, Dresser and McKee, Consulting Engineers, for Metropolitan Area Planning Commission; Alternative Regional Water Supply Systems for the Boston Metropolitan Area, February, 1971, pp. 59-76.

by expanding its available yield from 3 to nearly 10 mgd. This additional supply should be more than sufficient to meet the projected additional demands of all three communities. Therefore:

- 11. Expand the Richardi Reservoir to serve Braintree, Holbrook, and Randolph. The existing Richardi Reservoir should be expanded to its full estimated capacity of 10 mgd before 1990 to serve Braintree, Holbrook, and Randolph.**

Weymouth could use its existing ground water capacity more fully by treating standby sources to remove high concentrations of iron. This action would assure adequate water supplies through 1990 and would be more economical than immediate connection to the MDC. The SENE Study recommendation is as follows:

- 12. Treat existing standby wells in Weymouth to meet 1990 needs. Weymouth should treat existing standby wells within the next five years in order to meet 1990 needs.**

A preliminary study of an extension of the MDC to serve Braintree, Holbrook, Randolph, and Weymouth has been completed and the legislature has approved \$17 million for design and construction of the pipeline. However, engineer-

ing design and construction and the augmentation of existing MDC sources will require several years before water can be expected to flow into the South Shore coastal area. The SENE Study recommendation for these municipalities reads as follows:

- 13. Make best use of local resources in south coastal municipalities. The municipalities in south coastal area of the Boston Metropolitan planning area should make the best possible use of local resources in order to postpone the need for importing MDC water. However, all six towns should begin planning for MDC service to supply their long-range water needs.**

Implications

This chapter has attempted to stress the SENE Study's policy of reliance on local and in-basin water resources before turning to interbasin transfers of water. Although many municipalities in the Boston Metropolitan planning area must rely on the MDC as a source of water supply, others will be able to develop additional local resources. The reliance of planning area municipalities upon local ground water and intertown surface water resources will ease future pressures on the MDC's sources of supply.

CHAPTER 5 WATER QUALITY

Water quality problems differ for each of the three major river basins of this planning area and for Boston Harbor. The amount of wastewater treatment where sewers exist varies from town to town. Table 5.1 illustrates the planning area's sewer systems, the population they serve, their degrees of treatment, and the waters which receive their discharges.

The Situation

Mystic River Basin

The headwaters of the Mystic River, the Aberjona River, and the Mystic Lakes have Class B water quality goals. At present, the Aberjona is not meeting that classification. The Mystic River from the outlet of the Mystic Lakes to the Amelia Earhart Dam does not meet even the requirements of a Class D river. The state's goal is to upgrade it to Class C quality. SC classification is the goal for the tidal section.

The towns in the Mystic basin are all members of the Metropolitan District Commission's Metropolitan Sewerage District and wastewaters are conveyed to the Deer Island wastewater treatment facility where they receive primary treatment. Many of the stormwater and municipal wastewater systems in Chelsea and Somerville are combined, releasing tremendous pollution loads to the harbor during storms.

More than half of the total acreage of each town in the basin is urbanized. Woburn has the least land in urban uses — 54 percent, but is under medium-high development pressure; Medford the greatest — 90 percent. In all, 75 percent of the area is urbanized. As expected, this extremely high degree of urbanization, with its vast amounts of impervious pavement, results in high storm runoff loaded with oils and grease from

roadways, sand and silt, and organic matter. The tidal portions of the Mystic River and Chelsea Creek — major commercial waterways — are rimmed by petroleum product tank farms. Plans for recreational development (*discussed in Chapter 6*) are not distant from this pollution source. To reduce the amount of oil released from these drainage systems, recent discharge permits issued by Massachusetts and EPA require installation of oil separators.

Charles River Basin

The Charles River is a meandering stream which, within the watershed's 31 mile straight-line length, traverses 79 miles. Twenty dams on the river affect its normal fall of 350 feet. The longest stretch between dams is the 20.8 river miles from the Medway Dam to the South Natick Dam.

The Charles River meets its water quality goal only from its source to Dilla Street, Milford (Class A). From Dilla Street to Mine Brook, however, the river has Class U conditions. From Mine Brook to Watertown Dam, the river is classified as C₁ and C₂. The Charles again has a Class U assignment from the Watertown Dam to the Charles River Basin Dam. Water quality goals for the river below Dilla Street are Classes B and C.

The existing water quality problems on the Charles are due primarily to sanitary and industrial waste discharges at its upper reaches. Inadequately treated municipal wastewater discharged to the upper Charles at Milford and to Mine Brook and Stop River contributes much to the degradation of the river. Another major cause of degradation in the Charles basin is the wastewater from two industries in Millis, presently being discharged to Sugar Brook. Both industries are now planning pretreatment of their wastes before disposal. Further downstream, active decomposition ceases,

TABLE 5.1 SEWER SERVICE: BOSTON METROPOLITAN PLANNING AREA

Sewer System	1970 Population Served	Degree of Treatment	Receiving Waters
Milford	18,200	Secondary	Charles River
Franklin	8,202	Secondary	Mine Brook
Millis	2,080	Secondary	Sugar Brook to Charles
Medfield	1,473	Advanced	Charles River
Metropolitan Sewer District			
Deer Island	1,300,000	Primary	Boston Harbor
Nut Island	700,000	Primary	Boston Harbor
Hull	4,400	None	Atlantic Ocean

but the nutrients added to the river from the tributaries and other wastewater treatment plants cause heavy growth of aquatic plants. Leachate from three poorly sited municipal dumps in Milford, Newton and Waltham, will continue to release nutrients to the river and aggravate plant growth for some time, even though the Milton site was to close in late 1975. Nutrient leachates and algal blooms are problematic on nearly the entire Charles River. These problems are compounded in the middle reaches by pollution from urban runoff, and in the lower basin by combined sewer overflows and salt water stratification, which inhibits natural purification processes. The results in the lower basin are black, oily, and probably toxic benthic deposits. Bacterial concentrations in the lower basin discourage its use for any water contact recreation.

All of the towns within the Route 128 perimeter are served by the Metropolitan District Commission sewer system. Outside the Route 128 perimeter, Wellesley and Natick are also served by the Metropolitan District Commission. Millis, Medfield, Franklin, and Milford operate individual treatment facilities discharging to the Charles and its tributaries. The rest of the towns in the basin use individual subsurface disposal systems.

Neponset River Basin

The Neponset River's natural sluggishness, coupled with its past use for the disposal of raw wastewater from factories and mills, has made it one of the most critically polluted of all the rivers in metropolitan Boston.

A water quality survey of the Neponset conducted by the Division of Water Pollution Control in the summer of 1973 indicated that water quality was generally below Class C for dissolved oxygen with wide fluctuations due to algal growth. The Foxborough State Hospital has installed a physical/chemical advanced treatment facility, which should greatly improve conditions immediately downstream.

Other pollution problems include urban runoff, combined sewer overflows from Boston's system, and the sludge deposits which have formed behind paper mill dams. Several industries with production process wastewaters have connected to municipal sewers. All the towns in the Neponset basin except Sharon are served by the Metropolitan District Commission system.

Boston Harbor

Boston Harbor is traditionally defined as those waters subject to the rise and fall of the tides inside a line from the southerly tip of Deer Island to Point Allerton in Hull. The harbor is considered to be the fourth priority area in SENE for application of restoration recommendations (*Chapter 5, Regional Report*). Most of the harbor, currently classified Class SC, has an ultimate water quality goal of SB. However,

a section of Boston Inner Harbor west of a line from the southerly tip of Governor's Island to Fort Independence, including the Charles, Mystic, and Chelsea (Creek) Rivers and Fort Point Channel, has a lower water quality goal of SC which it is presently meeting. In addition, Quincy Bay from Bromfield Street (near the Wollaston Yacht Club) north to buoy "C 1" and southeast to the "Willows" (sometimes known as Lord's Point), on the northerly shore of Hough's Neck in Quincy, is meeting a higher water quality goal of SA. This situation is important for sustaining high quality shellfish beds.

The harbor faces severe water quality problems resulting from combined sewers, the primary discharges from the Deer and Nut Island treatment plants, oil pollution, debris and refuse, and vessel pollution. Efforts to remedy these problems are vital to the realization of the harbor's full recreational and marine resource potential (*Chapters 6 and 7*).

The Solutions

Preservation

For the reasons outlined in *Chapter 5 of the Regional Report, Water Quality*, the SENE Study places highest priority on the preservation of the Boston Metropolitan planning area's high quality waters. Preservation will be especially important in the Upper Charles and the Upper Neponset river basins where there are wildlife and flood control wetlands sensitive to the vagaries of water quality changes. Recognizing the high quality tributaries in parts of this planning area, the Study endorses the anti-degradation policies of the Division of Water Pollution Control as stated in the water quality standards, and encourages efforts to:

1. Carry out current Massachusetts non-degradation policies. In Massachusetts, the Department of Environmental Quality Engineering should ensure that no new discharges will deteriorate the quality of stream water above the most upstream municipal discharges and Class SA and SB waters (shellfish harvest and swimmable-fishable salt water), with conditioned exceptions.
 - (a) to allow new cooling water discharges if standards of the receiving waters are met;
 - (b) to allow new municipal discharges if part of a comprehensive plan; and
 - (c) to require existing discharges to cease and either connect to a municipal system or provide high degrees of treatment consistent with maintaining high quality waters.

This recommendation must be of high priority in the Boston Metropolitan planning area if the quality of its tributaries are to be preserved.

Because a large portion of this planning area is urbanized, it is also important that a second preservation recommendation be made. Stormwater runoff from highly developed areas is an important source of water pollution, and steps should be taken to reduce it. Consistent with the discussion in *Chapter 5 of the Regional Report*, the SENE Study recommends that municipalities in the Boston Metropolitan planning area:

2. **Attenuate runoff from new urban developments.** The Massachusetts Department of Community Affairs should encourage the municipalities to adopt subdivision controls which emphasize open areas and the use of permeable drainage ditches. Municipalities should also provide attractive and safe stormwater detention ponds, thereby also augmenting ground water recharge.

Restoration

Where water pollution problems exist in the planning area, programs of restoration must be emphasized. Regulation and permitting of discharges and construction of treatment facilities can be used to achieve proposed water quality goals. Major pollution problems in the Boston Metropolitan planning area include urban stormwater runoff, industrial discharges, oil pollution, and municipal discharges. Landfill leachate and watercraft wastes are two other less serious sources of pollution in this planning area. These problems are especially intense within densely populated municipalities.

Combined Sewers and Stormwater Runoff. As in many older, developed areas, much of metropolitan Boston is served by combined storm and sanitary sewers, many of which were constructed in the late 1880's. During dry weather periods, these municipally owned sewers discharge to a system of interceptors that are operated by the Metropolitan District Commission (MDC), and the waste is transported to the MDC primary treatment plant at Deer Island. However, during periods of rainfall, the combined sewers and interceptors reach their capacity, and the excess flows are discharged to nearby water-courses at numerous overflow points.

The inadequacy of existing regulator devices and tide gates has compounded the combined sewer problem in the Boston area. Many of the tide gates in Boston were either missing or in need of repair. However, the MDC in an intensive program has recently repaired almost all of the tide gates and blocked regulators in the system. Previously, significant amounts of sea water entered the system at high tide, reducing its efficiency and increasing the cost of water trans-

port and treatment. At low tide, wastewater sometimes entered the receiving waters during dry weather periods. As a result, overflows of combined sewage degraded the quality of the waters of Boston Harbor and sections of the Mystic, Charles, and Neponset Rivers. Significant concentrations of bacteria, oxygen demanding wastes, and suspended solids are discharged to the receiving waters when overflows occur.

Several major projects which the SENE Study endorses are underway in this field. Currently, there is one treatment facility in operation on the Charles River in Cambridge near the Boston University Bridge (Cottage Farm Stormwater Treatment Station) which reduces the frequency of overflows, the volume of wastewater, and the concentration of pollutants discharged through combined sewer overflows to the river. The Cottage Farm Station also disinfects the effluent. A similar facility is under final design in conjunction with the construction of a new dam at the Old Warren Avenue Bridge. An added benefit of this dam will be the potential for the elimination of salt water stratification in the Basin. Cambridge is currently undertaking a five year program to provide partial separation of combined sewers which will result in combined sewer overflows only during storms of a magnitude greater than the 5-year storm. Tide-gate maintenance and repair in Boston by the MDC is progressing; separation of Brookline's combined sewers has recently been completed.

Because of the highly urbanized nature of many parts of the planning area, it is important that stormwater sampling be carried out in order to provide a rational basis for a badly needed non-point source abatement program. The SENE Study recommendation is as follows:

3. **Begin stormwater and wet-weather stream sampling.** In the Boston Metropolitan planning area, the Massachusetts Department of Environmental Quality Engineering should begin a major year-round stormwater and wet-weather stream sampling program.

This program could be especially important for the Mystic and Neponset Rivers where industrial discharges are not major, and runoff is correspondingly important. The program should also be instituted on the Charles River. In addition, sewer separation may be implemented for some of the communities in these basins. Unlike treatment techniques, combined sewer separation will not improve the quality of urban runoff reaching a water body. Therefore, water quality goals may never be realized unless the runoff problem is solved.

Industrial discharges. Industrial pollution in this planning area is being brought under control by the National Pollutant Discharge Elimination System of industrial permits. Indus-

trial dischargers must connect with municipal treatment facilities following pretreatment, or must provide adequate treatment on-site. The SENE Study endorses efforts to:

4. **Continue current industrial permits program.** The U.S. Environmental Protection Agency should continue its current industrial permits program which is part of the National Pollutant Discharge Elimination System.

Oil Pollution. The magnitude of the oil pollution problem in Boston Harbor, resulting from spills during ship-to-shore transfers, stormwater runoff from streets, as well as tank farms and combined sewers, is such that, in one instance, a permanent oil boom has been placed across Chelsea Creek, a major oil storage and transfer area for metropolitan Boston, to help contain chronic spills.

The major discharges of oil to sewers have, in virtually every case, been traced to fuel oil losses resulting from failure of tanks, pipes, and mechanical equipment, or from human error. The oil enters the sewers either by infiltration or directly through a catch basin. Continued vigilance by the Coast Guard, EPA, and the Massachusetts Division of Water Pollution Control will help to control this potential threat to water quality. However, prevention by all persons handling oil is the key to fewer spills.

Municipal Discharges. The following discussion presents a facilities-oriented approach to upgrading the quality of the Boston Metropolitan planning area's waters.

The two primary treatment facilities at the ends of the MDC system are the Deer and Nut Island Plants. The Commonwealth of Massachusetts has entered into an agreement with the U.S. Environmental Protection Agency to determine the most feasible means of achieving a minimum of secondary treatment at the two facilities. In addition, sludge disposal methods will be investigated to eliminate sludge discharges to the Harbor, probably a more important aspect of the treatment works than provision of secondary treatment. While the Federal Water Pollution Control Act Amendments of 1972 specify a minimum of secondary treatment for all publicly owned treatment works by July 1, 1977, the situation for the Deer and Nut Islands plants requires a reevaluation of that date given limited financial resources. It appears that the funds which would be spent upgrading the Deer and Nut Island treatment facilities might be better spent on the combined sewer problems of the area in order to maximize water pollution control benefits. Some type of legislative action on the federal level would be necessary, however, to postpone the July 1, 1977 requirement. All other requirements of the Act concerning dates and degrees of treatment for this planning area are endorsed.

Figure 5.5 in the Regional Report, Proposed Wastewater Treatment Systems and Facilities, illustrates the locations

of facilities which are designed to improve water quality in all ten planning areas. It is obvious that no single action will provide suitable water quality for the Boston Metropolitan planning area because of the complex water quality problems which exist. In addition to the programs to alleviate the problems of combined sewers, described above, several other major treatment projects are underway in the Boston Metropolitan planning area, which are, briefly:

- (a) An advanced wastewater treatment facility has been completed in Medfield.
- (b) A secondary treatment facility will be constructed in Hull, eliminating five untreated discharges.

The Boston Harbor-Eastern Massachusetts Metropolitan Area Wastewater Management (EMMA) Study is a major effort to propose and evaluate advanced wastewater management systems for 109 communities in the metropolitan area. The EMMA Study considered five alternative concepts of wastewater treatment. Many of the proposals considered by the EMMA Study were initially outlined by the Massachusetts Division of Water Pollution control or regional planning agencies.

The following preliminary proposals have been made by the EMMA Study as parts of their alternative concepts, and are favored by the SENE Study. Basin plans developed by the Massachusetts Division of Water Pollution Control should further evaluate these proposals to determine their technical feasibility.

The EMMA Study includes among its proposals the following two options which the SENE Study endorses:

- (c) Milford should upgrade its secondary plant to an advanced treatment facility discharging to the Charles River.
- (d) The Charles River Pollution Control District should construct an advanced treatment facility discharging to the Charles River in Medway to serve Franklin, Medway, North Bellingham, Holliston, and Wrentham. The western third of Norfolk will be served after 2000.

In addition, the EMMA Study has considered land application for some communities. The Study feels that land application of the towns' own wastes might be feasible, although more study must be undertaken. The SENE Study recommends that wastewater authorities:

5. **Give additional consideration to several land disposal sites.** Additional serious consideration should be given to the land disposal site identified by the EMMA Study in Franklin, Bellingham, and Wrentham in lieu of stream

discharge, or at least to lessen the size of a stream discharge.

Further discussion of land disposal may be found in the *Regional Report, Chapters 4, Water Supply, and 5, Water Quality*. If sufficient suitable land for application of treated wastewater in these municipalities is present, the proposal should not be ignored. However, further study is necessary to determine the economic and environmental feasibility of such a project, as well as the health hazards associated with it.

The SENE Study also recommends other EMMA Study options, specifically those to:

6. Connect southern Bellingham to the Woonsocket treatment facility.
7. Expand Medfield's treatment facility to serve Millis, if possible. Medfield should expand its advanced facility to serve Millis. However, because of a large industrial flow in Millis, this may be difficult to implement. In that case, Millis should upgrade its facility to advanced.
8. Construct advanced facility in the middle Charles basin to serve the western suburbs. An advanced satellite treatment facility should be constructed in the middle Charles to serve Hopkinton, Southborough, Ashland, Framingham, Natick and Wellesley.

This treatment plant would also serve two municipalities after 2000: Dover and Sherborn.

9. Construct advanced facility in Canton to serve southern suburbs. An advanced satellite treatment facility should be constructed in Canton discharging to the Neponset River and serving a large section of Canton, most of Norwood, Stoughton, Walpole, and Sharon. Chapter 3, *Guiding Growth*, suggests that all these communities have increasing development pressures. The Metropolitan District Commission or a regional authority would construct and operate the treatment facility. In addition, consideration should be given to use of an identified land disposal site in Sharon to serve that community.

The satellite facilities would be constructed to minimize expansion of the Nut Island treatment facility. All other communities currently on the MDC system will continue to be served by the Metropolitan Sewerage District.

In addition, Weston and Holbrook are considering future MDC sewer service. The two Harbor facilities will expand as needed and will provide secondary treatment.

Studies have been made concerning sludge disposal, and results have indicated that incineration is the most feasible alternative. Investigations are continuing, however, due to citizen and legislative concern over possible air pollution effects.

Preliminary construction costs are presented for the preceding alternatives and include only major interceptors and treatment facility costs: MDC member communities \$95,000,000; Milford – \$2,750,000; Bellingham – \$4,000,000; Medway – \$1,900,000; Franklin – \$6,000,000; Holliston – \$500,000; Wrentham – \$4,000,000; Norfolk – costs borne after 1990; Millis – \$3,000,000; Medfield – \$6,000,000; Hull – \$6,500,000.

Septic Systems. Another threat to water quality is malfunctioning septic systems. These have resulted in the preceding proposals for sewer service and attendant treatment facilities. Rigid enforcement of existing regulations may preclude many of the problems of these systems. However, an in-depth look at the criteria for locating, siting, and designing individual subsurface disposal systems is also necessary since some aspects of existing regulations may still allow problems to develop. For example, high percolation rates coupled with the minimum allowable depth to ground water may result in bacterial contamination, nitrate build-up, or even phosphate build-up in that ground water. Also, allowing systems to be placed in fill material might invite clogging conditions at the fill-old surface interface.

There is a real need for Massachusetts to thoroughly review and update its regulations regarding individual disposal systems, and support for this has been voiced by citizens. With proper enforcement, and by restricting the use of such systems to those lands suitable for septic tanks, individual disposal systems should continue to be useful for an important portion of future residential development. Without such precautions, the cumulative failure of individual systems will intensify pressure for sewer extensions and new treatment works. The result will be new concentrations of effluent in high quality streams, loss of in-basin ground water resources, increased municipal service costs, and, inevitably, the increased density of development induced by sewer service.

Landfill Leachate. Rigid enforcement of sanitary landfill regulations is another task of the Department of Environmental Quality Engineering. Towns which have been identified as having landfills which produce problems associated with surface drainage, leachate, and lowest portion of the fill in the water table include: Boston, Winthrop, Cambridge, Milford, and Ran-

dolph. Sites in Waltham, Winchester, and Woburn experience only the first two problems. Sites in Belmont, Needham, and Wellesley experience only the last problem. Therefore, the SENE Study recommendation is as follows:

- 10. Study and define the landfill leachate problem.** The Massachusetts Department of Environmental Quality Engineering should make further field investigations and studies to better define the extent and nature of water quality problems associated with existing and abandoned solid waste disposal sites, with a view to developing adequate perspectives and rational controls.

The SENE Study endorses the efforts of the Water Resources Commission which has an ad hoc commission studying the problems of solid waste.

Pleasurecraft Wastes. The number of pleasurecraft operating in the waters of the Commonwealth is increasing rapidly every year, and so are the wastes they discharge. Unless the discharge of sewage from these boats is brought under strict control, state officials anticipate that many shellfish and bathing areas will have to be closed. At present, state officials favor requiring "tight tank" systems (resulting in no discharge) as the only devices that will assure positive and adequate protection for these bathing and shellfish harvesting areas. Emphasis on this system will result in the need for adequate onshore pump-out facilities at marinas or

coastal municipal treatment plants. While current U.S. Coast Guard regulations allow certified discharges in certain cases, it appears that the goal of these regulations is the ultimate elimination of all such discharges and that the current regulations are a worthwhile first step in controlling vessel pollution.

In order to aid in the implementation of recent Coast Guard regulations on the disposal of vessel wastes and move towards the elimination of even certified discharges, the SENE Study recommendation is:

- 11. Provide pump-out facilities for watercraft wastes, until other methods are more feasible.** The Massachusetts Department of Environmental Quality Engineering (a) should have publicly owned treatment plants along the coast which provide pump-out facilities: the three coastal treatment facilities at Deer Island, Nut Island, and Hull should construct these facilities; and/or (b) should require all marinas in heavily congested harbors and adjacent to major harvestable shellfish beds and swimming areas to provide pump-out facilities with either adequate treatment or disposal to a municipal system.

CHAPTER 6 OUTDOOR RECREATION

Approximately 9 percent of the Boston metropolitan planning area presently is dedicated to recreation and conservation uses (28,000 acres), and nearly half the open land is state owned (13,000 acres). Large tracts of land such as the Blue Hills Reservation (5,700 acres), Middlesex Fells Reservation (2,000 acres), and Stony Brook Reservation operated by the Metropolitan District Commission (MDC) are among the major publicly owned areas for hiking, nature study, swimming, and occasionally, boating and canoeing. The Charles River Reservation (1,500 acres) ensures public access to a prime recreational resource for sailing, canoeing, and walking. Plans to develop the Mystic and Neponset Rivers in a similar fashion are currently on MDC's drawing boards and implementation of them is imminent. Private organizations, such as the Trustees of Reservations and Massachusetts Audubon Society, and local town commissions have significantly managed to protect over 14,000 acres of conservation and recreation land.

However extensive these existing resources, there will not be enough of them to meet future recreational demands. Hence, recreational use of resources in other parts of the region will intensify over the next 20 to 40 years. The Bureau of Outdoor Recreation estimates that this planning area's outdoor recreational demands are by far the greatest in the SENE region. Existing beach area can meet 10 percent of the estimated 1990 swimming demands; existing picnic facilities could meet about a fifth of the 1990 demands; existing publicly available natural areas could meet about a quarter of the estimated 1990 demands for extensive outdoor recreation.

One of the SENE Study's prime strategies is to make up recreational deficiencies in urban areas in order to absorb some of the pressures on outlying recreational resources. Also, providing recreation opportunities in urban areas enhances environmental quality and improves accessibility of recreational facilities for urban residents. *Chapter 3, Guiding Growth*, suggests that attracting growth to well serviced urban centers has economic and environmental benefits.

SWIMMING

The shoreline of Boston Harbor is very irregular with peninsulas, embayments, and islands combining to form about 130 miles of coast. The shore is a combination of ledge, gravel till, and man-made bulkheads, granite wharves, and timber pilings in various states of disrepair and erosion.

There are about 42 active beaches around the harbor, with the South Boston beaches probably the most important

as neighborhood opportunities. Some are publicly owned town or state beaches with heavy use. Others are privately owned and may, or may not, be open to the public, and may, or may not, be used extensively. During the summer bathing season, Revere, Nahant, and Nantasket Beaches, run by the Metropolitan District Commission, are overcrowded on warm days and particularly on weekends. Other beaches in the harbor are not fully used because of inaccessibility (such as the Harbor Islands), because of inadequate facilities (such as parking areas, bathhouses, or rest rooms) or they may be occasionally closed due to water pollution problems described in *Chapter 5*.

The 42 beaches total approximately 19.2 miles in length, of which 95 percent are publicly owned. There are presently 96 acres of publicly usable beach in Boston Harbor. Given participation rates discussed in the *Regional Report* and the projected increase of about a million residents in the planning area, this amount of usable beach will satisfy about 10 percent of the 1990 demand.

Even now, a large scale weekend migration from the urban Boston area occurs to outlying beaches. This migration is placing increasing use pressure on some fragile and high quality environmental areas in addition to wasting energy, and increasing traffic congestion and pollution. There are substantial opportunities elsewhere to provide more readily accessible swimming for the urban residents while reducing the above mentioned environmental problems. Therefore, the SENE Study recommends the Metropolitan District Commission (MDC):

1. **Study best method to widen and protect Nantasket Beach. Additional improvements such as play areas, pavilions, and bath houses should be made in conjunction with the town of Hull's projected urban renewal for the area adjacent to the MDC beach.**
2. **Improve access along the Dorchester waterfront, including connecting Tenean Beach, Malibu Beach, and the Neponset River. Improvements and pedestrian tunnels are needed under the expressway from the Dorchester neighborhood and the Savin Hill MBTA station to the beach.**
3. **Improve facilities at three beaches. The Metropolitan District Commission should construct a bathhouse and additional toilet facilities on Wollaston Beach and continue improvements to Merrymount Park and Blacks Creek marsh. Any plan to alter Blacks Creek area**

must be coordinated with fish and wildlife interests.

4. Construct one bathhouse in the City Point Beach-Carson Beach area and continue existing maintenance and landscaping programs to preserve their excellent condition.
5. Provide parking and access to Moswetuset Hummock, including a small foot bridge to connect the island to the parking area, and restore the tidal creek that surrounds the hummock.

These recommendations aim to improve swimming opportunities through the most cost-efficient methods. Therefore, the Study rejected costly recommendations to construct new beaches. The success of the recommendations for satisfying future swimming needs depends on the achievement of water quality standards set forth by the Massachusetts Division of Water Pollution Control, and in part on the implementation of recommendations described in *Chapter 5, in this Planning Area Report and the Regional Report*.

RECREATIONAL BOATING

Boston's fine harbor and numerous coves provide outstanding anchorages for recreational boating. The 14 cities and towns which border the harbor have a total of 16 boat landing ramps, and 57 recreational landings. Based on a 1972 Corps of Engineers airphoto count, the approximate recreational boating fleet by town is presented in Table 6.1.

Estimates of 1990 demands for additional boating facilities have taken into account potentially higher inflation rates, fuel costs, maintenance rates, and increased insurance and

tax costs, all potential modifiers on demands. Based on such considerations, and given expected population growth, an additional 660 boating spaces could be required. Following a physiographic, land use, and accessibility analysis, the estimates were derived by the Corps of Engineers for each town's boating development potential (Table 6.2).

Provisions for more boats should not automatically mean more marinas. Alternatives to additional marina slips may be increased use of fore-and-aft-moorings, and on-shore high rise dry slip storage.

The SENE Study recommends the appropriate agencies take the following actions:

6. Establish state boating advisory committee. The Departments of Fisheries, Wildlife and Recreational Vehicles and Environmental Management should establish a boating advisory committee made up of representatives and boating interests to advise and work with state and local governments. Working to meet a major portion of future boating needs with fewest environmental impacts, such a committee could help plan and foster orderly boating growth, and encourage private investment development of marina and dry-storage facilities wherever feasible. *Details are found in Chapter 6 of the Regional Report.*
7. Consider fore-and-aft mooring practices. The harbor masters should consider the possibility of initiating fore-and-aft mooring practices in protected anchorages in the more crowded harbors in order to reduce the mooring space required per boat.

**TABLE 6.1 EXISTING RECREATIONAL FLEET BY MUNICIPALITY:
BOSTON METROPOLITAN PLANNING AREA**

Municipality	Slips	Moorings	Total	Sportfishing Boats
Arlington	20	---	20	---
Boston	565	425	990	18
Cambridge	85	30	115	---
Chelsea	--	20	20	2
Medford	125	45	170	3
Milton	10	30	40	1
Newton	85	10	95	1
Quincy	975	710	1,685	5
Somerville	55	---	55	--
Watertown	70	5	75	--
Braintree	130	30	160	0
Weymouth	190	170	360	1
Hingham	315	530	845	5
Hull	140	350	490	3
Totals	2,765	2,355	5,120	39

8. Continue maintenance of 13 recreation channels. The Corps of Engineers, in conjunction with the Massachusetts Department of Public Works, should continue the operational maintenance of the recreational channel through the bar north of the head of Long Island which connects President Roads to Nantasket Roads; the Fort Point Channel to the Congress Street Bridge; the Charles River Channel to the Arsenal Street Bridge and on to the Galen Street Bridge in Watertown; the Mystic River Channel to Craddock Bridge in Medford; the Malden River Channel; the Dorchester Bay and Neponset River Channels; the two Quincy Bay yacht club channels; the Town River anchorage; the Weymouth Back River Channel; the Hingham Harbor Channel; the Weir River Channel; and the Allerton Harbor Channel in Hull. Care should be taken in maintenance projects to avoid disturbing shellfish beds, shallow waters, and wetland areas valuable to fish and wildlife uses.

9. Develop boat ramps and parking facilities. The Massachusetts Department of Public Works, in conjunction with municipalities, should maximize the number of slips and moorings available in each harbor consistent with local conditions and opportunities. They should also develop additional public boat ramps and parking facilities wherever feasible and appropriate.

The possible development of a new marina in Boston Harbor is discussed in *Chapter 7, Marine Management*.

An important river for access to recreational boating in Boston Harbor is the Weymouth Fore River. However,

upstream of the General Dynamics shipyard in Braintree there is a problem with shoaling which is restricting boat passage from the Metropolitan Yacht Club, and a public boat ramp. The municipalities of Braintree and Weymouth should request either the Corps of Engineers or the Commonwealth to determine the economic feasibility of a channel improvement program.

BOSTON HARBOR ISLANDS PARK

The Boston Harbor Islands Park currently under joint development by the Department of Environmental Management and the Metropolitan District Commission, is contributing vastly to revitalizing the Harbor, reclaiming it for public use and enjoyment, and preserving and enhancing the unique character of the islands. The special historic and natural qualities of the islands provide rare opportunities for cultural, recreational, and aesthetic experience for the residents and visitors in the metropolitan area. The potential accessibility of this park to urban Boston residents is its most valuable characteristic.

During the first six months of 1975, great strides have been taken to implement the Metropolitan Area Planning Council's 1972 Harbor Islands Comprehensive Plan. Three islands are being developed and managed for recreational and conservation purposes and are accessible to the public by means of a free water taxi service. The areas under use are:

George's Island – National Historic landmark;
Fort Warren.

Recreational Development Plan:
Major stop on Boston-Nantasket ferry line,
family picnic facilities, partially restored
Fort Warren.

TABLE 6.2 RECONNAISSANCE OF POTENTIAL RECREATIONAL BOATING FACILITIES*

Municipality	Potential Additional Slips	Potential Additional Moorings	Potential Additional Spaces
Boston	450	210	660
Cambridge	135	10	145
Medford	140	30	170
Milton	0	50	50
Newton	0	10	10
Quincy	130	180	310
Somerville	120	0	120
Watertown	20	20	40
Weymouth	170	60	230
Hingham	200	60	260
Hull	30	60	90
Total	1,395	690	2,075

* These are preliminary estimates and should not be construed as justification for marina development or expansion. Further study – either by towns or by the proposed statewide boating advisory committee (see recommendation 5 in *Chapter 6 of the Regional Report*) – is needed to determine capacities for accommodating more boats.

Gallop's Island — Low hill, shrub cover; beach.

Recreational Development Plan:
Swimming beach, picnic areas, dock
and ferry boat landing.

Lovell's Island — Fort Standish, major beach.

Recreational Development Plan:
Group camping, saltmarsh interpretive trail,
wildlife management area, patrolled swim-
ming beach, picnic area, administrative
center.

One of the SENE Study's two highest priority recommen-
dations is:

10. Complete developing Boston Harbor Islands Park. Consistent with the Harbor Island Plan prepared by the Metropolitan District Commission and by the Metropolitan Area Planning Council for the Massachusetts Department of Natural Resources, (now Department of Environmental Management), the SENE Study endorses the following actions as appropriate to islands under their jurisdiction and encourages completion of the plan:

Deer Island — Fort Dawes; correctional in-
stitute; wastewater treatment plant; 100 foot
high hill grassy and open.

Proposed Recreational Development Plan —
Three-mile bicycle trail, children's recreation
area, informal park for viewing, picnic areas,
beach, environmental interpretive center,
ferrylanding, small boat dock and offshore
moorage area.

Long Island — Large harbor; causeway to
shore; Fort Strong; Long Island Hospital;
wooded areas.

Proposed Recreational Development Plan —
Visitor center-ferry landing, grass playgrounds,
restored Fort Strong, swimming beach, picnic
and outdoor eating areas, wetland interpretive
center, trail system and bike path, boat dock
and fishing pier, group camping sites.

Thompson's Island — Thompson Academy;
orchards; productive marshes.

Proposed Recreational Development Plan —
model farm similar to Audubon's Drumlin
Farm, saltmarsh wildlife sanctuary, swimming
beach.

Castle Island — Fort Independence and
popular well-used recreation facilities. Con-
tinued support is essential for MDC to com-
plete its plans.

Proposed Recreational Development Plan —
Restoration of important historic resource.

Brewster Islands — 100 foot drainline; sparse
vegetation; many bedrock ledges; abandoned
gun sites; historic Boston Light.

Proposed Recreational Development Plan —
Creation of Boston Harbor Outer Sanctuary
to assure preservation and natural manage-
ment of valuable resource, primitive camp-
sites, self-guided nature trails, small boat
docks, underwater park for scuba divers to
explore old shipwrecks and marine environ-
ment.

Peddock's Island — Fort Andrews; 5 hills with beach
connections; dense woods; extensive beaches.

Proposed Recreational Development Plan —
Three-mile bike loop, group camping, playfields,
saltmarsh interpretive center, wildlife manage-
ment area, Harbor Island Inn, restoration and
conversion of Ft. Andrews buildings into environ-
mental education center.

The Study supports the idea of federal legislation which
would authorize \$20 million to set up a commission and
to further the development of a Boston Harbor Islands
Park.

Together the 15 Harbor Islands owned by the state could
service up to 1500 recreational visitors each day, or as many
as 390,000 visitors annually in an April to November season.
The Harbor Islands Park, in combination with the other
recreation recommendations in the chapter, would un-
doubtedly satisfy a significant portion of the recreational
demands in the metropolitan area over the next 20 to 40 years.

Two very important precautions must be kept in mind when
developing the Boston Harbor Islands Park. The first is the
provision of an adequate and inexpensive ferry service, par-
ticularly to islands not accessible by automobile. The second
is the protection of Critical Environmental Areas from in-
tensive uses, particularly the smaller, fragile ones scattered
throughout the harbor.

GENERAL OUTDOOR RECREATION

With development inching steadily into surrounding open
spaces, local, state, and federal governments, and even pri-

vate land owners, must move quickly to acquire additional space for camping, picnicking, and extensive activities. Recreational demands are competing with future residential, commercial, and industrial development demands for the same open spaces in municipalities with development pressures. Another contribution to the recreational pressures, peculiar only to this and the Blackstone planning area, is the fact that cities in the center of the metropolitan areas (Somerville, Chelsea, Cambridge, Boston, Quincy, and Brookline) offer very limited recreational opportunities.

Assuming a recreational standard of 7.5 acres/1000 persons, Chelsea (with 1.0 acres/1000) and Somerville (with 1.3 acres/1000) are the most severely deficient of the municipalities within the Boston and Providence metropolitan areas; and the situation is certain to worsen before it gets better. Quincy and Brookline have substantially better distribution of total recreation acreage. Inspection of resources in these cities showed many local and city-wide areas not yet developed or under-developed, or, in some cases, not easily accessible to the major center of population.

The major reason for the gross deficiencies in recreation opportunities in municipalities like Chelsea and Somerville is the severe financial limitation under which core cities are operating, effectively preventing a program of improving and expanding the quantity and quality of recreation services. Considering the existing austerity budget of core cities, it would appear that neither the ratio of recreation budget, nor the proportion of the city's total budget it comprises, will improve significantly. With the urban land pressures, and thus land prices, as they are, this precludes substantial land acquisition programs to meet the city's needs. Planning and recreation officials in the towns surveyed perceived little opportunity for the city to significantly add to the recreation land resources by the conventional land acquisition program.

In light of this situation, it is necessary to look for solutions other than simple acquisition of land. The Bureau of Outdoor Recreation (BOR) suggests that opportunities exist for increasing both the acreage and the improved efficiency in recreational use of urban lands. The SENE Study recommends that cities:

11. Improve inner-city recreational opportunities. Inner cities in the Boston metropolitan area, especially Chelsea and Somerville, should improve inner-city recreation opportunities through the use of available acquisition means including fees, increased efficiency at existing areas, and multiple uses of public lands in several ways:

- Increase the availability of community school facilities.

- Develop multiple use of highway corridors, public work lands, and parking areas.
- Develop improved pedestrian access to existing urban parks.
- Develop a major program of soliciting land and easement donations.
- Develop a formal review system of tax title lands by planning and recreation agencies.
- Develop adequate recreation and open space in urban renewal areas.
- Consider the feasibility of re-routing commuter oriented bus service on weekends to better serve recreation areas, especially major beaches.

Natural river systems represent high value for conservation and recreation. The Mystic and Neponset Rivers have scenic, historical, and recreational qualities which are for the most part underutilized. Prospects for realizing the Neponset River's recreational potential are brighter now that the legislature has authorized funds for MDC's improvements. The Weymouth Back River, according to a March 1973 report by the Massachusetts Division of Marine Fisheries Monograph # 14, has great recreational and fisheries potential, if water quality were improved to proposed standards. Further, plans have been made to improve the Mystic River Reservation. However, certain stretches of the Charles River, also have extremely high recreation and scenic value, and should be protected. To develop rivers for recreational use, and to meet Study goals of enhancing environmental quality, protecting Critical Environmental Areas, and improving recreation opportunities near metropolitan centers, it is recommended that the state:

12. Designate the Charles as an initial component of the scenic rivers system. The Commonwealth should implement its existing scenic rivers legislation and designate the Charles as an initial component of a scenic and recreational river system.
13. Expand the Mystic River Reservation. The Metropolitan District Commission should pursue its plan to expand the Mystic River Reservation and develop a continuous corridor along the Mystic River, partially landscaped from Boston Harbor in Boston through Everett and Chelsea. The plan includes acquisition of vacant riverside areas in Charlestown, and the Little Mystic Channel and rights-of-way through other developed portions.

This action would contribute important picnic areas, walkways, bikeways, rental facilities, and play areas. Implementing recommendations for the harbor discussed in *Chapter 5* would enhance this plan.

14. Develop park behind the Amelia Earhart Dam in Somerville and Everett, including shore landscaping, boat launching ramps, boat rental facilities, picnic areas, walkways, and play areas. Upgrading the water quality to state standards will enhance the recreational potential of this stretch of the River. Access should be provided from the MBTA transit stop proposed for the area, just east of Wellington Circle, and a pedestrian overpass at I-93 from Somerville.

15. Acquire parts of the surplused Chelsea Naval Hospital. The Metropolitan District Commission should acquire all, or parts of, the surplus Chelsea Naval Hospital for recreation and open space purposes, with special attention to river front property.

There are numerous opportunities within the planning area to expand existing recreational facilities, and to make recreational use of other publicly owned resources. The recommended opportunities are as follows:

16. Develop Middlesex Fells Reservation and expand Blue Hills Reservation. The Metropolitan District Commission should develop more facilities at Middlesex Fells Reservation and expand Blue Hills Reservation. More picnic and parking facilities and trails could be added to Middlesex Fells Reservation without adversely affecting the wilderness-like quality. Citizens have voiced a strong concern for restoration of the Fells. The Metropolitan Area Planning Council has proposed that the Metropolitan District Commission could expand the Blue Hills Reservation by at least 2,100 acres.

These actions would provide 5 more acres for swimming, 60 more acres for picnicking, 10 more acres for camping, and over 2,000 acres for nature study, photography and walking. The costs would exceed several million dollars.

17. Expand Wompatuck State Park. The Massachusetts Division of Forest and Parks should expand the Wompatuck State Park to include adjoining surplus military land, when it is available in Hingham, and suitable private land in Cohasset and Scituate.

18. Expand Rocky Woods, Noon Hill, and Hale Reservations. The Trustees of Reser-

vation should expand Rocky Woods and Noon Hill Reservations and develop land for picnicking and camping. The Hale Reservation should also be expanded.

19. Develop Hallet Street Dump. The Metropolitan District Commission should pursue plans to stabilize and develop the Hallet Street dump site for recreation, including boat launching areas, playing fields, tennis court facilities, and landscaping.
20. Connect two parks with a stub of land near I-95. To connect the proposed Neponset River Reservation with Blue Hills Reservation and to protect the Fowl Meadow used for water supply by Dedham and Canton, the Metropolitan District Commission would gain ownership of some land at the undeveloped corner of I-95, now owned by DPW.

21. Acquire access to Massapoag Lake. The Massachusetts Department of Environmental Management should acquire public access to Massapoag Lake to provide for swimming boat ramps, and conservation of natural areas. Public access should also be acquired on the Neponset River upstream from Rt. 128 in Norwood, Canton, Walpole, and Sharon.

Many water supply reservoirs in the Boston Metropolitan planning area are valuable potential recreational resources. They have persisted as such because water authorities, legally bound to protect the quality of drinking water supplies, prohibit trespassing for any purpose. Extensive outdoor recreation (nature study and photography) is not necessarily a threat to water quality, nor is it illegal, particularly for storage (secondary) reservoirs. However, such limited forms of recreation are rarely permitted by municipal authorities, probably because of misgivings or management problems posed to water authorities. Finances large enough to acquire natural areas of equal quality and size are difficult to pull together, and social pressures for recreational use of water supply reservoirs will mount. To satisfy extensive outdoor recreational needs, the Study recommends:

22. Develop guidelines for low intensity recreation on secondary reservoir lands. With the Departments of Environmental Management and Environmental Quality Engineering, local water authorities and concerned citizens should prepare guidelines for non-contact recreational use of storage reservoir lands. Local water authorities should allow public access to reservoirs for hiking, picnicking, and nature study; including Great Pond Reservoir in Braintree and Randolph; Great Pond in Weymouth, Reservoir Pond in

Canton; Willet Pond in Walpole; Cambridge Reservoir, Sandy Pond in Lincoln; MDC reservoirs in Chestnut Hill, Weston and Sudbury.

Yet another possibility for multiple use development is the Southwest Corridor Project involving five rail tracts and an arterial street from South Cove to Forest Hills. The project would involve the relocation of Stoney Brook, now an ordinary and convenient sewer. Recreational values of this project would be realized if parts of Stoney Brook, with upgraded water quality, were opened and a bikeway and esplanade constructed.

Plate 1 shows the location of Critical Environmental Areas, which, as *Chapter 3* explains, have important roles in natural processes such as riverine and coastal flooding and erosion protection, water supply, and wildlife protection. They can also be used for varying degrees of recreation, at least for low-intensity activities. Since protection and development of such resources is best coordinated at the local level, municipalities should:

23. Use Critical Environmental Areas identified on SENE Development Capabilities Map (Plate 1) for open space protection and greenbelt programs. Methods for protecting such resources without outright acquisition are described in *Chapter 3* of the *Regional Report*.

Mill ponds are one kind of Critical Environmental Area which offer great potential for satisfying extensive recreational demands in the Boston Metropolitan planning area, if the two problems of access and repairs were solved. Mill ponds were created when the Mill Acts in the latter part of the 19th century authorized mill developers to seize, by eminent domain, lands important for the production of water power. The logic was that power production was in the public interest. Now that most of them have been abandoned, the question remains to whom do access rights, reversionary rights, and first choice to gain water rights, belong. Public access for recreation should be gained by means of new legislation. But access rights cannot be gained without some assurance that the dams are safe. Experience with Bogastow Pond in Millis would indicate that most mill dams are in disrepair, that owners do not have the finances to restore them, and that the choice is to breach. To ensure their recreational and flood control functions, the Commonwealth must pursue a program to repair and maintain private small dams.

Implications of Swimming, Boating, Harbor Islands and General Recreation Proposals

The Bureau of Outdoor Recreation estimates that these actions could provide several acres of beaches for swimming

which, with existing resources, could help meet nearly a tenth of the 1990 demands; several hundred additional acres for picnic facilities which, with existing resources, could help meet over a third of the 1990 demands; over a hundred additional acres for camping, which, with the existing resources, could help meet about a quarter of the 1990 demands; and almost 10,000 acres of natural area, which, with the existing resources, could help meet just under half the total 1990 needs for extensive outdoor recreation.

These actions are directed at meeting a significant and feasible portion of needs radiating from the most densely populated portions of the planning area. They stress enlarging the existing recreational lands (Mystic and Neponset River Reservations, Blue Hills and Middlesex Fells Reservations), or making recreation opportunities out of already publicly owned facilities (water supply watershed lands, public works, and abandoned lands in center cities). Citizens of the Boston Metropolitan planning area participating in public workshops strongly favored expanding existing parks and natural areas to increase the amount of recreational opportunity. They were less favorable to increasing the amount of public access to privately owned land. Also of some importance to citizens attending the meetings is the acquisition of new natural areas, such as the Study's recommendations regarding Boston Harbor Islands. This is an important step toward meeting the enormous outdoor recreation demands of the metropolitan area.

State or federal governments should have most of the responsibility for implementing these actions because the costs exceed the means of most municipal budgets. The Land and Water Conservation Fund is a potential source for state and local efforts, while the Communities Development Act is a potential source for action in municipalities. Meanwhile, efforts to open up recreation lands through zoning, acquisition, easements, as exemplified by the "Charles to Charles Plan" sponsored by the Boston and Brookline Conservation Commissions, illustrate how much can be done with imaginative local leadership. Recommendations for trail development described in the *Regional Report* indicate the need for the state Trails Advisory Committees to identify suitable locations for motorized and non-motorized vehicles.

WILDLIFE AND FRESH WATER FISHERIES

Relating to the SENE region as a whole, the Boston Metropolitan planning area does not possess a great deal of wildlife habitat. Less than 60 percent of the area is either forest, agricultural, wetlands, or open water. About 80 percent of the area's forest land is rated as fair wildlife habitat, and about 30 percent of the planning area's wildlife habitat is open to hunting. Publicly owned land and land open to public hunting amounts to about 2,000 acres; and another

67,000 acres are privately owned and open to hunting. If this total remained open through 1990, it would support only 1 percent of the 1,400,000 recreational days projected for this planning area. Insufficient wildlife habitat both in extent and variety, and a lack of public access to the existing resource base are the major factors limiting fulfillment of this demand.

Wildlife

Consistent with the SENE Study policy of protecting wetlands and other Critical Environmental Areas to provide opportunities for extensive pursuits and hunting, and to enhance environmental quality in this highly urbanized planning area, the Study recommends:

24. **Use Natural Resources Planning Program to enforce wetlands legislation.** Conservation commissions using technical assistance available from the Natural Resources Planning Program should strive to enforce existing wetlands protection legislation. This Program is administered by Conservation District Offices with the Executive Office of Environmental Affairs.
25. **Use Self-Help Funds to acquire significant wetlands.** Using Self-Help Funds administered by Department of Fisheries, Wildlife, and Recreational Vehicles, municipalities should consider acquiring wildlife wetlands. *Chapter 8* discusses forthcoming wetland acquisitions in the upper Charles River basin, one component of the Corps flood management program for the River. SENE Study Single-Purpose wetland inventories have identified these especially productive areas which should also be considered for acquisition: (a) Charles River basin – the Indian Brook wetlands in Sherborn; Charles River, especially the headwaters, the Trout Brook area in Dover and Needham; the Mill River area in Norfolk; the Beaver Pond area in Bellingham; the Beaver Pond area in Franklin; the Stone Brook area in Norfolk and Wrentham; the Bristol Blake Reservation wetlands in Norfolk; wetlands on the state prison lands in Norfolk; and the wetlands by the south end of Lake Pearl in Wrentham; (b) Neponset River Basin – the shallow marshes north of Turner Pond in Walpole; the Beaver Brook and Massapoag Brook wetlands in Sharon; the wetlands bordering the Neponset River in Sharon, Canton, Norwood, Westwood, Dedham, Milton, and Boston; the wetland south of the town farm in Milton; the area on the northwest side of Ponkapoag Pond in Randolph and Canton; and the wetland along Meadow Brook in Walpole and Sharon.

Edges between forest, field, and wetlands are often the most productive wildlife habitats. One of the Study's major policies is the protection of prime agricultural lands, wetlands, flood plains, and unique natural areas (components of Category A and B resources). Actions to protect these resources – *described in Chapter 3 of the Regional Report* – have secondary benefits for the wildlife enthusiast or hunter because they preserve habitat.

Wildlife management programs if instituted on Category A and B lands would improve the quality of wildlife habitat and could support approximately 14 percent of the 1990 demands. Information was not available to ascertain the effectiveness of options such as arranging state management of privately owned wildlife lands in exchange for public access, or the possibility of enlarging the boundaries of state hunting areas. Private organizations also will play increasingly important roles in protecting valuable wildlife habitat. Past experience indicates that most wildlife enjoyment occurs on privately, or quasi-privately, owned lands.

An option of acquiring public access to all 232,000 acres of wildlife habitat was not recommended because hunting is prohibited in several towns, because of the expense involved, and because public preferences expressed at the Boston Metropolitan planning area workshop did not support the idea of public access to privately owned land. Creating new wetlands was not recommended for the near future, because the high costs involved in initial outlay would be better spent in acquiring wetlands which already exist, and are known to be highly productive. However, the Study supports research into creating wetlands – especially using dredged materials – for the long-run.

Fresh Water Fisheries

Of the 108 (7,095 acres) fresh water ponds 10 acres and larger within the basin boundaries, only 4 (194 acres) ponds have guaranteed state-wide public access; 31 (2,767 acres) ponds have town or municipal access; 48 (1,924 acres) have informal access; and 25 (2,210 acres) are water supply reservoirs or private ponds closed to fishing. Of the 225 miles of stream the amount in public ownership and open to fishing is negligible. If these waters had adequate public access and were under fisheries management, they could support about 470,000 man days of fishing per year, approximately 12 percent of the 1990 demand.

As mentioned previously in this chapter, water supply watershed lands offer recreational potential – even fishing. However, demands are most assuredly met if opportunities are acquired for recreation. The Study recommends.

26. **Acquire public access to potentially most productive streams.** The Massachusetts Division of Fish and Game should acquire public access to 15 streams of good and best fisheries potential, if it is not now

provided (*identified on SENE Study single-purpose inventory information available in NERBC files*). Among the most important are:

Stoney Brook — Charles River, Waltham and Weston; Bogastow Brook — Charles River, Millis; Beaver Brook - Massapoag Brook, Sharon; Stop River - Charles River, Medfield; Mill River - Charles River, Norfolk; Eagle Brook - Mill River, Norfolk; Mine Brook, Franklin; Neponset River, Canton; Massapoag Brook, Canton; Beaver Brook, Sharon; Hawes Brook, Norwood; Pine and Mills Brooks, Walpole.

The Great Ponds Law is a colonial statute for providing fisheries and other recreational opportunities, whose potential has not been fully realized. Many ponds in the planning area qualify as "great ponds" and the Department of Public Works, and its predecessors, have identified a number of them. Presently, a natural great pond is defined for recreational purposes as a natural pond 10 acres or larger, but for fishing purposes as a natural pond of 20 acres or larger. Changing the definition of fishable ponds to 10 acres would greatly improve opportunities for fishing. Additionally, public and municipal cooperation in permitting public access to "great ponds" is needed in order to meet rising demands for fresh water based recreation.

To ensure a relatively inexpensive means of meeting fishing demands, the Study recommends the following actions:

27. Change Great Ponds legislation and acquire access to potentially most productive ponds. The Massachusetts Legislature should change the existing Great Ponds Act to designate ponds 10 acres and larger for fishing. The Public Access Board should plan to acquire access to about 86 ponds of ten acres and larger, of good and best fisheries potential. The lengthy listing of appropriate sites is available from *SENE Study Single-Purpose inventories available in the NERBC files*.

Implications

The combined recommendations for fresh water fishing would succeed in meeting nearly 10 percent of the total 1990 demands. The alternative of creating impoundments was not considered because of the high costs and low return on satisfying 1990 demands. Public sentiment against expanding licensing programs for salt water fishing is very strong, even though many fishermen are unlicensed (*see Chapter 6 of the Regional Report*). The option of expanding the license program was therefore not recommended.

CHAPTER 7 MARINE MANAGEMENT

The major marine-related issues in the Boston Metropolitan planning area concern port development, offshore fisheries, potential offshore sand and gravel mining, and urban waterfronts. Additional information on each of SENE's marine-related topics can be found in the *Regional Report Chapter 7, Marine Management*. That report covers, from a regional perspective, offshore fisheries, shellfish and aquaculture, port development, offshore sand and gravel mining, and urban waterfronts.

PORT DEVELOPMENT

Boston Harbor, the largest seaport in New England, consists of an outer harbor formed and protected by islands and peninsulas which are natural boundaries for Hingham, Quincy, and Dorchester Bays, and an inner harbor formed by the confluence of the Charles and Mystic Rivers. The two harbors comprise a combined area of approximately 50 square miles, bounded by 180 miles of shoreline and dotted with 30 islands, totalling approximately 1200 acres.

As a major port, Boston offers complete port facilities and services to the regional economy, ship operators, and the shipping public. Custom house brokers, domestic and international freight forwarders, steamship agencies, several steamship company branch offices, and many related services are actively serving steamship company and shipper needs.

The port facilities of Boston consist of 156 piers, wharves, and docks, 29 of which are designed for petroleum products handling. Seventeen (17) others function as general cargo terminals, 69 as berthing and repair facilities, and the balance is divided among specialized terminal types for the handling of liquid natural gas (LNG), cement, chemicals, salt, and seafood. Established in 1969 and operated by the Massachusetts Port Authority (Massport), the newer of two Boston container terminals handled over 78,000 units in 1973, a three-fold increase since 1970 when 26,000 units were handled. In terms of overall tonnage, Boston ranked as 15th busiest port in the nation in 1972, handling 26.5 million tons from 13,000 vessel trips.

The Situation

Various federal, state, and municipal agencies exercise control within the jurisdiction of their areas of responsibility, but the Marine Division of Massport was established in 1956 by a state Legislature Enabling Act, and commenced its mission of ensuring the development and maintenance of a safe, efficient, economical, and modern transportation system for the Commonwealth in 1959.

Massport's Marine Division controls only those marine-related facilities owned or leased by Massport, and has no authority over other public or private properties in the port. Its facilities total 22,700 linear feet of berthing space for deepwater vessels, 2,148,000 square feet of cargo storage sheds, a 1.3 acre dockside freezer, and nearly 50 acres of open-air container storage yards.

In addition to the properties owned or leased by Massport, other piers, wharves, and docks of Boston are owned and operated by private corporations (see Table 7.1). Additionally, there are various small facilities owned by federal, state, and municipal authorities used for non-commercial activities such as the U.S. Coast Guard, police and fire boat berthing, and private small craft berthing. Eight facilities are available in Boston for construction, repair, or conversion of vessels ranging from oceangoing ships to private pleasure boats. In addition, there are four floating drydocks ranging in lifting capacities from 2,000 to 18,000 tons, four graving docks ranging in length from 256 to 938 feet, and four marine railways with capacities ranging from 100 to 300 tons. Eighteen tugs and two boats are in service to assist with towing and docking at Boston, Quincy, and Salem. Ship chandlery services, bunkering facilities, and floating heavy lift cranes are also available.

One of the largest shipbuilding plants on the Atlantic Coast is located along the Weymouth Fore River in Quincy, on the south side of Boston Bay. It is equipped with 12 launching ways and 3 mooring basins.

Of all the SENE ports, only Boston has a capability to handle containers in any volume. Table 7.2 presents the cargo types and amounts for the Port during the 1972 sample year. The port was off to a late start in the containerization boom, but has grown considerably from 2,135 twenty-foot container equivalents in 1969, to 26,460 units in 1970. Each subsequent year saw substantial growth and the Massachusetts Port Authority has estimates of 78,000 units for 1973 with average weight of 20,000 pounds.

TABLE 7.1 BOSTON PORT CHARACTERISTICS

Recreational Terminals	37
Fish Terminals	7
Commercial Terminals	59
U.S. Navy Terminals (Active & Surplus)	22
Marine Services and Repair Terminals	65
Inactive Terminals	15
Fishing Boats	30
Lobster Boats	20
Waterborne Commerce in tons (1972)	26,483,38

The success of the Boston Mystic Public Container Terminal operation has caused Massport to plan continued expansion with another fifty acres of marshalling area, and the acquisition of an additional gantry crane for the container handling. The agency has plans to create a roll-on/roll-off facility, as well as a small tank storage farm at the terminal. The continued development of modern containerization facilities is essential in order to continue to attract, and to enlarge, the volume of general cargo moving through the port.

From the regional standpoint, the biggest problem facing not only Boston, but all SENE port operations today, is the general lack of coordination of port development schemes, terminal construction plans, and inland distribution systems, particularly for petroleum. In a market as distinct as that for SENE, the region's ports would be more efficient if they were planned jointly to complement, rather than conflict with, each other. Planning for development of future key facilities at ports best equipped to handle a given commodity would benefit the shippers, the port itself, and the region as a whole. This has been borne out by the success of Massport's container operations. Additional regional economic analysis is needed to determine the extent to which regionalism should play to serve SENE and New England.

There have been many proposals recently, for example, for development of deepwater oil terminals for both the greater Boston and Providence-Narragansett Bay area. The need for both facilities — especially in light of similar proposals in other parts of New England — has not been analyzed. These proposals have been made in a policy vacuum, without benefit of a port development plan within a regional context.

While it was not within the scope of the SENE Study to conduct such analyses, it would appear that the current development of LNG facilities on Narragansett Bay might be further pursued. Similarly, deepwater petroleum facilities development near the Boston Metropolitan area might also be further pursued. Massport has studied multi-user offshore petroleum terminals with pipelines to various in-

land tank storage or refinery areas. A deepwater offshore terminal would alleviate existing and projected tanker congestion and the threat of spills in the port of Boston. Coupled with a pipeline distribution system to major population centers — Worcester, Providence, and Fall River-New Bedford — this central petroleum receiving facility could provide for the region's oil needs in a safer and more efficient manner than is currently the case.

Such a scheme anticipates, and is contingent upon, eventual inland refinery construction and deepwater crude oil shipments. Further detailed discussion is included in *Chapters 7 and 9 of the Regional Report*. With such a large market within such short distances, it would appear that specialization would benefit both ports, as well as be more commercially attractive to potential investors.

The Solutions

Based upon the preceding discussion, the following actions are recommended to sustain and improve the competitive standing of New England ports:

1. **Develop a regionwide port development strategy.** Massachusetts and Rhode Island, as well as Connecticut, New Hampshire, and Maine, through the New England Regional Commission and with assistance from the New England River Basins Commission, should jointly undertake a regional port planning program. Federal participation should include the Corps of Engineers, Department of Commerce, U.S. Coast Guard, and the Maritime Administration. The central objective of the program should be to determine the most economically efficient port development system for meeting the region's petroleum needs, and to some extent its shipping and cargo distribution needs. The study should also consider: (a) the various navigation projects proposed to serve petro-

TABLE 7.2 WATERBORNE COMMERCE BY PRODUCT GROUPS:
BOSTON HARBOR AREA

Product Group	Tons	Percent
Petroleum Products	23,327,292	88.1
Food and Agricultural Products	783,090	3.0
Nonmetallic Mineral Products	775,443	2.9
Scrap Metals	605,820	2.3
Metal Products and Machinery	314,910	1.1
Forest Products and Manufactures	178,249	0.7
Chemicals	152,673	0.6
Crude Petroleum	128,195	0.5
Rubber, Leather, and Textile Products	103,481	0.4
Other Commodities	92,863	0.3
Fish, Shellfish, and Marine Products	22,154	0.1

leum distribution facilities, existing or potential power plants, or possible refineries which might be constructed; and (b) cost-sharing measures, that would be submitted for consideration by Congress, concerning federal assistance for local port planning purposes, and federal assistance to state authorities for port improvements.

2. **Maintain 9 channels in Boston Harbor.** The Corps of Engineers should continue to actively maintain all deepwater commercial navigation channels in Boston Harbor including: the North, South, and Nantasket Roads Channels; the President Roads Anchorage; the Inner Harbor main ship channel; the Chelsea River Channel. Additionally, the Corps of Engineers should maintain the 35-foot access channel through Hingham Bay to Weymouth Fore and Town Rivers, and the mooring and turning basins at the Fore River Shipyard in Quincy.
3. **Consider deepening two channels in Boston Harbor.** The Corps of Engineers should consider the deepening of the 35-foot reaches of the main ship channel and the Mystic River channel to 40 feet.
4. **Attract new private investments to the Port of Boston.** The Massachusetts Port Authority should continue its efforts to attract private investments to continue wherever feasible, consistent with port development priorities (*see Urban Waterfronts section of this report*).

There are navigation and vehicular traffic problems associated with the Fort Point Channel and its 61-year-old Northern Avenue Bridge. The tentative proposal for a new bridge with 15-foot vertical clearance at mean high water would meet the needs of lobster boats currently berthed upstream of the bridge, but would not be passable by the larger marine construction work boats that also berth immediately upstream from the bridge. City officials are exploring possible arrangements whereby the work boats could relocate to a new berth area that would be developed seaward of the proposed fixed bridge.

The following recommendations are made:

5. **Improve Fort Point Channel.** The City of Boston should decide if the Fort Point channel upstream from Congress Street should be retained as a reflecting pool (assuming necessary water quality improvements), or developed for other uses, or whether portions

should be filled in as part of the ongoing redevelopment of the nearby South Station area. There are no active terminals in this portion of the Channel. To fill the Channel the City must request the U.S. Congress, authorized to regulate navigable waters, to declare this portion of the Channel non-navigable.

6. **Relocate work boats upstream of Northern Avenue Bridge to Pier 7.** City of Boston should investigate the relocation of the marine work boats and lobster boats berthed upstream of the Northern Avenue Bridge to nearby sites. One possible relocation site would be the inactive 2,000 square foot area at the southwest end of Pier 7, the westernmost of the South Boston Naval Annex piers that were declared surplus in July, 1974.
7. **Consider new marina between Northern Avenue and Congress Street.** In the event that the existing work boats and lobster boats (now berthed along the east side of the Fort Point Channel between Northern Avenue and Congress Street) could be relocated, this east bank area would provide excellent opportunity for much needed marina which could be developed by private interests into a facility that could service a minimum of 160 recreational boats.

Implications

Because of the extremely high capital costs involved, future port development plans will have to be regionwide in scope. No one port can be expected to be internationally competitive without support of the region as a whole. Competitive port development programs resulting in duplication of facilities, in spite of regional traffic projections which indicate limited regionwide demand, are in neither the national nor the regional economic interest. In the long-run they may not even be in the local interest. Implementation of the Study's recommendations on port development will permit a degree of control over liquid and bulk commodity handling in the region and could give a significant boost to the region's shipping and cargo industries in major port cities, such as Boston.

COMMERCIAL FISHERIES

The Situation

Boston has slipped from its previous ranking as the leading New England fishing port during the early 1950's. At that

time its receipts roughly equalled the combined totals for Gloucester and New Bedford, then the second and fifth largest New England fishing ports. Boston now ranks lower than both Gloucester and New Bedford. Although over half of the fish receipts at Gloucester and New Bedford represent landings by foreign vessels, Boston still ranks fourth in New England in terms of receipts from U. S. fishing boats.

The principal problem for the commercial fishing boats still remaining in Boston Harbor, in addition to the need for harbor improvements, is the need for conservation measures in the offshore fishing grounds. The Boston Harbor fishing fleet has declined sharply in recent years because the offshore fishing grounds have been overfished by foreign fishing fleets, and most of the American fishing boats are relatively old and unable to compete on equal terms.

It is widely agreed that most traditionally fished stocks found off our northeast coast are now harvested near, or beyond, their capacity to sustain themselves. It follows that any new potential to support growth should come from "underdeveloped" fisheries resources. And in most cases, harvesting these species requires a financial risk, added fishing effort, plus new processing technology and marketing. Three abundant resources that are not fully utilized are offshore crabs, squid, and various mixed finfish species such as sea herring, dogfish, small silver hake, red hake, and butterfish. Many of these mixed species are now caught regularly, but are not brought ashore due to low market values. These caught, but unused, fish stocks have been estimated to be as much as 50 to 75 million pounds, or about 20 to 30 percent, of current trawl landings.

As noted in *Chapter 7 of the Regional Report*, the New England Fisheries Development Program initially seeks to develop the three above-mentioned underutilized resources. It also will encourage new marketing techniques by the industry to take advantage of the increased consumer demand and hopefully to blunt the 70 percent share of the domestic market which foreign imports have captured. If new markets can be developed for these species it would mean an economic boost to the industry. It has been estimated by fisheries development officials that an increase of one percent a year in landings for 10 years would mean perhaps another \$4.2 million to the fishermen and vessel owners.

The New England Fisheries Development Program is looking toward developing a method for handling mixed species catches of fish at sea, part of which may be used to make fish blocks. These are frozen blocks of fish flesh from which fish portions and sticks can be produced. Research is needed, too, to develop an automated system to process large quantities of small, irregular sized fish and to sort them into groups.

There is an additional, though somewhat lesser problem that will affect the Boston-based fishing fleet in future

years. The problem concerns the redevelopment of the Atlantic Avenue waterfront, which was declared to be non-navigable waters in 1968 by Public Law 90-312. During the past 15 years, the number of commercial fishing piers in the Atlantic Avenue area has dwindled from five to two, although the fishing fleet landed 22,000 tons of fish. The continued loss of fisheries facilities to non-marine oriented uses should be halted and, in conjunction with a broad-based revitalization program, additional wharfage and processing facilities should be developed (see following section on Urban Waterfronts).

The Solutions

Consistent with the policy of maximizing the region's commercial fishing industry, the following actions are recommended:

8. Study upgrading the Boston Fish Pier.

The Massachusetts Port Authority should study the feasibility of upgrading the facilities at the Boston Fish Pier to permit more rapid processing, packaging, and distribution of fish products. Efforts should be made, however, to retain the Boston Fish Exchange as an institution central to the character of Boston's waterfront.

9. Consider developing a new fish pier in Boston Harbor. Assuming that the Boston Harbor fishing industry can be revitalized by modernization of the local fleet and by effective conservation measures in the offshore fishing grounds, consideration should be given by Massport for setting aside an existing pier, in addition to the existing Boston Fish Pier, which would be required to meet the potential needs of a revitalized fishing industry (also see *Urban Waterfronts recommendations*).

10. Continue to support an interim offshore 200-mile economic zone. Local fishermen and politicians should continue to urge the U.S. Congress to extend, as soon as possible, the nation's jurisdiction over fisheries to 200-miles offshore or to the edge of the continental shelf. This recommendation would provide better control over the offshore resource base as an interim measure pending final proposals by the Law of the Sea Conference.

11. Support national fisheries management policy. A national management policy should be locally supported by the fishing industry. The establishment of this joint

federal-state management program would allow limited foreign entry, quota enforcement, seasonal or species control limitations, and fishing gear specifications within the 200-mile economic zone. The objective of the preceding actions would be to increase the supply and variety of fishery products without depleting the stocks of any given species.

12. **Improve market for underutilized fish species.** The local commercial fishing industry, with technical assistance from National Marine Fisheries Services under the New England Fisheries Development Program, should actively develop a domestic market for underutilized fish species by applying innovative marketing techniques in educating the public to the use of new fish stocks.
13. **Accommodate coastal fish facilities through improved planning.** The Coastal Zone Management Program, in cooperation with Departments of Community Affairs, should jointly prepare development guidelines with the Boston Redevelopment Authority and other municipal planning agencies. Technical assistance should be provided when making land use or zoning bylaws for shore-based support services for commercial fisheries, such as fish or shellfish processing plants, or updated docking and transshipment facilities. Such planning should also carefully consider Critical Environmental Areas (SENE Categories A and B) so as to protect those estuarine resources which are of vital importance to the commercially valuable offshore fisheries (also see *Urban Waterfronts recommendations*).
14. **Allow privately financed purchase of foreign-built fishing vessels.** Congress should consider repealing the law prohibiting the purchase and importation of foreign-built fishing vessels to allow their use specifically in depressed fisheries states if purchased with private capital. Federal monies should not be granted for purchases of such foreign vessels.

Implications

Implementation of these actions would be a major step toward regenerating Boston's fishing industry which, despite its decline, still represents an important economic activity. In time, given enlightened management and federal support, a healthier, more stable fishing industry could become an

even more significant force in the economy of the region, making a major contribution to regional income and generating development of related processing, storage, and shipping facilities in existing ports.

It is possible that as fishing fleets modernize, they will be considered by some as less aesthetically desirable assets to coastal communities, leading eventually to pressures to isolate them. The various processing activities associated with the fishing industry have in the past suffered less than total acceptance. However, the negative externalities of smell and waste generally associated with them pose less a problem than do the adverse impacts of many other industries. These fishing-related processes are subject to relatively less expensive, and less complicated, anti-pollution technologies than many of the more complex industries. In addition, commercial marine fishing is one economic activity for which there is no alternative to locating in the coastal zone. Thus, to some extent, the harbor facilities required by the fishing fleets will compete with other coastal industries and some private recreational uses (see *Urban Waterfronts recommendations*). However, in general, the facilities associated with the fishing industry are compatible with many recreational uses, and most other industrial activities which do not depend on waterfront sites can find alternative locations within the region.

URBAN WATERFRONTS

The Situation

New England's port cities were largely responsible for the area's rapid economic growth and development in the eighteenth and nineteenth centuries. As noted in New York's "*Waterfront Workshop*" conducted by the City's Planning Commission in 1974:

"Time and technology have left stranded many once-busy segments of the waterfront. Brickyards, stoneyards, lumberyards, and coal terminals have either gone out of business or moved elsewhere. Containerization has shifted the volume of shipping business, and airlines and cruises have transformed passenger ship piers.

These changes have opened up the waterfront's potential, although in a double-edged fashion: because one type of development usually precludes all other alternatives, proposals may generate counter-proposals. A housing plan is met with the suggestion that a park would be preferable, a plan to site industry may arouse environmentalists, a plan to turn over an idle pier for recreation may be attacked as a blow to shipping. Almost everyone

agrees that the shoreline is too valuable to be allowed to lie fallow, but agreement on a specific plan may be difficult to obtain. This is one of many contradictions enshrouding the waterfront."

In order to recapture the vitality which lies just beneath the surface of decay and neglect, a few institutional and administrative changes are needed, backed by public awareness. Several cities and towns have initiated or carried out sound programs for waterfront development or renewal, although their success has occurred in spite of, rather than because of, current institutional and public policy.

The future of Boston Harbor has become a critical issue in recent years, and the specific questions involved in this issue reflect economic and environmental changes that are affecting major seaports throughout the United States. Some are regional issues and some are local, but they all revolve around the search for the proper balance between the imperatives of economic growth and the need to improve the quality of the environment.

In Boston, there are a number of major illustrations of these issues involving the Harbor and its adjacent communities. They range from expansion of the airport and development of modern seaport facilities, to residential and commercial development on waterfront lands, greater public access to the waterfront, new recreation facilities, improvement of water quality in Boston Harbor, and protection of marine resources. A case of particular concern to both economic development and environmental protection interests is the reuse of Naval facilities recently made available (*see discussion in the previous section on Port Development and Chapter 7 of the Regional Report*).

The Boston Redevelopment Authority (BRA) is working on urban renewal projects in Charlestown, downtown Boston, and East and South Boston. Plans are being prepared for the reuse of Charlestown Naval Base and the Naval Yards on a 30 acre section of the Charlestown Navy Shipyard including the U. S. S. Constitution which will be one of the seven sites as part of the National Maritime Historic Park. In East Boston, major emphasis is being placed on using the waterfront for housing, open space, and schools, and in South Boston, the BRA is studying the most appropriate reuses of the South Boston Navy Yard.

The controversy over the Downtown Boston Waterfront Renewal project illustrates multifaceted characteristics of the issues surrounding redevelopment. The most recent revised plans that have emerged from the project place greater emphasis on the creation of waterfront parkland, physical and visual access to the water, rehabilitation rather than demolition of historic warehouses and wharves, and non-luxury residential development.

Public and private redevelopment activity elsewhere in the harbor has many of these same characteristics. In all these cases, the central questions not only have to do with what type of development occurs, but also whether or not it is a kind of development which will make the waterfront accessible to the public.

Throughout Boston Harbor, there is a growing demand for public access to the waterfront for both low-and high-intensity recreational purposes. Although the regional transportation network makes the general area of the harbor accessible to a large population, access to the water itself is often difficult. In some places, highways built along the waterfront block direct access. The Central Artery in downtown Boston and the Southeast Expressway at Malibu Beach are prime examples of this barrier effect. In others, commercial or residential developments on the waterfront have been designed in ways which impede visual or physical access.

One of the questions that runs throughout any consideration of the future of Boston Harbor is how to coordinate the efforts of the numerous public agencies that are responsible for its operation, regulation, and development. In 1968, the Metropolitan Area Planning Council listed 20 federal, state, and local agencies with key functions related to the Harbor. More recently, a representative of the Boston Harbor Associates expanded the number to 105 by including the myriad governmental divisions, and departments which had specific, separate powers. Regardless of the number, however, it is clear that one of the obstacles to the formulation of balanced policies and programs for the Harbor is the fact that institutional responsibility for the Harbor is highly fragmented.

The question is not how to give more power to one agency or another, but, rather, how to integrate, enhance, and coordinate the variety of powers and programs that already exist.

The Solutions

By integrating master planning and development control functions in urban waterfronts, local governments can focus public interest and concern on relevant development issues and establish administrative framework at the local level. In light of the previously discussed options, the following actions are recommended in order to enhance the reuse of urban waterfronts in a rational and balanced manner:

- 15. Coordinate local waterfront planning and development. Municipalities should prepare an inventory or plan for the long-term use or reuse of waterfront areas. In**

undertaking such activities, towns should give special consideration to factors such as the protection of flood prone areas, the preservation and enhancement of historic sites and buildings, the provision of public access easements (both physical and visual) in new development, building height, and so forth, consistent with Critical Environmental Areas as specified in the Chapter 3, *Guiding Growth*.

While prime responsibility for initiating and carrying out land use decisions should remain at the local level, the state should perform the following critical functions:

16. **Provide guidance and set criteria for priority waterfront uses.** Massachusetts, through its Coastal Zone Management Program, should develop urban waterfront planning and management guidelines, and criteria for deciding priorities for uses to be incorporated into local waterfront master plans. Priorities should be established for water-using uses, complementary uses, and low priority uses.
17. **Review and coordinate waterfront use.** Massachusetts, through its regional planning agencies, and Department of Community Affairs, should exercise its powers to review and revise major waterfront development proposals of more than local concern.
18. **Support state and local waterfront development plans.** The U. S. Congress and the Office of Management and Budget should approve adequate federal funding for state coastal zone planning programs, and for other planning programs which enhance waterfront redevelopment.

Implementation of coordinated local and state approaches to waterfront use should help to minimize fragmentation of decisions in waterfront areas, while recognizing the appropriate roles of the different levels of government. Agreement on appropriate guidelines and priorities should help to reduce conflicts between uses and increase the chances for a variety of uses along urban waterfronts.

More sensitive and sensible use of waterfronts will reinforce use of existing infrastructure and help to reutilize urban areas which have considerable economic and aesthetic potential.

OFFSHORE SAND AND GRAVEL EXTRACTION

The Situation

Although the rate of increase in demand for sand and gravel is beginning to slow as highway and building construction tapers off, the overall demand for these products can still be expected to increase in the next few decades. The Boston Metropolitan area does not appear to have sufficient on-shore sand and gravel deposits to meet its needs (*see Chapter 9, Locating Key Facilities*). Sand and gravel used in the Boston area is trucked in from more rural districts or hauled by rail from as far away as southern New Hampshire. The steadily increasing transportation costs of these construction materials has made the heretofore uneconomical extraction of offshore deposits more attractive in recent years.

Price increases of conventionally mined sand and gravel from June 1973 to June 1974 ranged from 10 to 50 percent in SENE. Moreover, in June 1974, the price of washed and screened concrete sand was \$2.33 per ton in the high-demand Boston metropolitan area. In contrast, industry experts now estimate that by 1976 far-shore sand and gravel could be extracted, processed, and delivered dock-side at \$1.00 per ton. Adding transportation to this dock-side cost, far-shore sand and gravel could be competitive up to 30 to 40 miles inland from port of entry.

The degree to which offshore sand and gravel mining affects the marine environment varies considerably by site. Some effects are known to be minor and temporary, others major and permanent, while for others little is known. Three areas of potential conflict exist: fisheries, recreation, and navigation and communications.

Given the importance of both the commercial and sport fishing industries to the SENE region, offshore mining will require careful scrutiny and more information than is presently available. From the research which has been done to date, it appears that if mining is restricted to far-shore waters, away from near-shore shellfish beds and delicate spawning grounds, detrimental effects to the fisheries would be minimal (*see Chapter 7, Regional Report*).

The mining industry appears to have anticipated these problems and has focused its attention and development on far-shore mining. In addition to the need to reduce conflicts with other uses, the industry is interested in far-shore mining because: (1) far-shore waters currently lay outside of state jurisdiction; (2) ocean transport costs are low; and (3)

recent technological developments have significantly increased the efficiency of mining in depths exceeding 100 feet (*see discussion on offshore sand and gravel extraction, Chapter 7 of Regional Report*).

Due to the configuration of marine sanctuaries in Massachusetts waters, the only possible mining site would be off Boston Harbor. This could pose navigational conflicts, but would be immediately accessible to the only market area in SENE which is immediately capable of sustaining such operations. Appropriate onshore sites along the Boston Waterfront, specifically along Northern Avenue, are underutilized and could be made available for transshipment of sand and gravel.

The Solutions

In the event that offshore mining becomes economically competitive, the following recommendations are presented, consistent with the Regional Report's policy of accommodating development while protecting the surrounding marine environment:

19. Develop a policy and program regulating commercial mineral extraction in coastal waters. The Massachusetts Coastal Zone Program should develop a policy and program regulating extraction activities in sensitive marine environs. Such a program would require knowledge about the location of particularly fragile coastal areas and about the kinds of impacts such activities would have. Appropriate regulations should be drawn up to minimize negative impacts. In the meantime, the Oceans Sanctuary Act should be clarified as to which agency has the authority to oversee these activities in near shore waters.

20. Coordinate future leasing of far-shore sand and gravel sites. The Massachusetts Coastal Zone Management Program, and appropriate departments in the Executive Office of Environmental Affairs should actively seek to have the Bureau of Land Management of the U.S. Department of the Interior, and the National Marine Fisheries Service of the National Oceanic and Atmospheric Administration coordinate their far-

shore sand and gravel licensing with the State to reduce potential conflicts. Such licensing should consider the following criteria as requirements: (a) living resources should not be jeopardized by construction or operation of mining devices; (b) mining operations should be timed to occur in waters not used as seasonal spawning areas by fish; (c) operators should be required to use latest equipment such as trailing suction hopper dredges capable of onboard processing.

21. Develop predictive modeling techniques for offshore sand and gravel operations. The above participants should seek funding for a study to develop an interdisciplinary predictive model capable of identifying post-operational biological, chemical, and physical effects of mineral extraction on living and non-living marine resources at alternative extraction sites. This effort will produce operational guidelines for industry regulation in order to improve offshore mining techniques and minimize adverse impacts on the fisheries resource.

Implications

In light of the direct relationship in mineral extraction between closeness to shore and potential environmental damage it is in the best economic and environmental interests of the SENE region for the states to virtually prohibit nearshore mineral extraction. The existing Massachusetts marine sanctuaries legislation regulates activities in almost all the State's coastal waters except offshore of Boston Harbor.

The program is also designed to support the far-shore mining operator, should such extraction be needed, by providing sensitive site selection mechanisms and clear operating criteria and regulations. By clarifying operating standards and identifying approved extraction sites, the program of recommendations provides opportunities for extraction while being sensitive to the importance of these same far-shore waters to the region's fishing industry (*see Chapter 7, Regional Report*).

CHAPTER 8 FLOODING AND EROSION

The Situation

Inland and Coastal Flooding

Previous floods in the Boston Metropolitan planning area have caused major damages in the lower reaches of the principal rivers where there has been extensive development in flood plain areas, particularly in the lower Charles. Uncontrolled land use in the planning area and the loss of existing flood retention areas is resulting in increased flooding. Residential and industrial expansion which reduces the storage capacity of natural bogs, swamps, marshes, and ponds will increase potential flood damage in the planning area.

In general, the Study's recommendations emphasize that both inland and coastal flood prone areas be protected from development by using non-structural solutions such as maximum protection of wetlands and strict development criteria, wherever possible. Only where there is high value development in small concentrated areas should development be protected from flooding by using structural solutions. Recognition of the multiple values of wetlands — not just as natural flood retention areas, but for wildlife habitat, water supply, recreation, and landscape quality as well — further strengthens the importance of wetlands protection as a policy for reducing flood damages.

Mystic River Watershed. Flood damages have occurred throughout the Mystic River watershed. Major floods on the Mystic River have been experienced in March 1936 and August 1955; other significant events were in October 1962 and March 1968. Many problem areas are along the tributaries due to local conditions and backwater effects. Significant problem areas include:

- the flood plain along Horn Pond Brook from the Woburn-Winchester town line to its confluence with Aberjona River;
- the lower portion of Mill Brook in Arlington;
- the area along Alewife Brook from the Mystic River to Little Pond;
- the vicinity of Malden Square;
- areas along the mainstem of the Mystic River in Arlington, Medford, and Somerville; and
- potential damage areas and nuisance conditions along the Aberjona River.

The Mystic River (Amelia Earhart) Dam is expected to alleviate most of the flooding problems in the lower portion

of the Mystic basin as soon as the pumping station at the dam has been installed.

Due to the large flood flows, flat river gradient, and existing channel restrictions that exist on Alewife Brook and the upper portion of the Mystic River, an additional pumping station on the Mystic River in the vicinity of the old Craddock Locks (near Medford Square) may be needed. Additional structural measures, such as channel modification, culvert enlargement, or flow diversion, may also be required to help alleviate the flood problems along Alewife Brook in the vicinity of Route 2. Further detailed studies will be required for the other local problem areas in the subwatersheds of the Mystic River drainage area in order to determine economically feasible solutions.

The upper portion of the watershed above Upper Mystic Lake is not, for the most part, intensively developed and consists of rural areas, parks, and moderately populated residential areas. However, recent commercial and industrial development has changed the drainage patterns of some parts of the area, making maintenance of existing channels, bridges, and culverts important. If development is allowed to continue, future problems may occur, especially in the upper portion of the watershed.

The opportunity exists for a program of comprehensive flood plain management which takes advantage of remaining natural valley storage areas. A number of lakes and ponds scattered throughout the Mystic River watershed act as detention areas for storing excess runoff during flood conditions. During dry periods they help to augment low streamflow.

In addition to these open water bodies, the inland wetland areas, which are located mainly in the upper portion of the watershed, help to store excess runoff during flood conditions and gradually release this water to streams during dry spells. The two major inland wetland areas in the watershed are those located along the Aberjona River in Woburn and Great Meadows in Lexington.

Charles River Watershed. Throughout the middle and upper watershed, flood damage at the present time is not extensive (approximately \$400,000 during the March 1968 flood). The relatively low flood damage is attributed principally to the extensive marshes and swamps along the Charles and its main tributaries. Flood peaks in these areas are so retarded by natural valley storage that they do not reach

the Lower Charles until three or four days after the flood peak generated downstream has passed. But for this characteristic, the Charles River Basin area would have suffered much greater damages in the past. In their Charles River study, the Corps of Engineers determined that a 40 percent loss of wetlands would increase flood stages in the middle and upper river from 2 to 4 feet, for a flood of the magnitude of the 1968 flood.

As mentioned in *Chapters 2, 3 and 6*, the Charles River Study Report of the Corps of Engineers has found that the magnitude of potential flood losses are sufficient to warrant the acquisition of the important natural valley storage areas as a multi-purpose project for flood control, recreation, and fish and wildlife management. The estimated first cost of the project was given in the report as \$7,340,000 for 8,422 acres covering 17 wetlands in 16 towns. The project was authorized in fiscal year 1974, and funds were available to the Corps in fiscal year 1975 to start detailed studies of the wetlands as a preliminary step toward acquisition. Detailed studies are expected to be a two-year effort; acquisition is expected to begin in fiscal year 1977. Conservation commissions, planning boards, and zoning boards of appeal in the 16 municipalities should continue to protect these wetlands from preemptive uses.

The characteristics of the lower reach of the Charles River vary markedly from those of the middle and upper reaches. In the downstream portion, the watershed is heavily urbanized, and conducive to both tributary and mainstem flash-flooding due to extremely rapid runoff. The lower Charles (below river mile 12) has experienced severe flooding. During the record flood of August 1955, damage in the lower Charles amounted to an estimated \$5.5 million. This flooding is caused by the rapid runoff from built-up areas of Cambridge and Boston. In the event of a recurrence of flood flows equivalent to those in the record 1955 flood, losses amounting to over \$12 million (at 1968 prices) in 2020 are estimated if wetlands continue to be lost at the present rate.

Another major project in the watershed is the construction of the new Charles River dam and pumping station. Begun in 1974 and scheduled for completion in 1977, the dam is expected to protect major damage areas along the lower Charles.

Neponset River Watershed. Flood damages in the past have occurred throughout the watershed. The basin has experienced extensive damage due to the past floods of 1936, 1938, 1955, and 1968. The flood caused by hurricane rains in August 1955 is the flood of record for this basin and has a frequency of occurrence of about once in 100 years. Damage areas included Diamond Brook in Walpole, Traphole Brook in Walpole and Canton, and Pine Tree Brook in Milton.

Two local protection projects have been constructed along two tributary streams, one on the East Branch at Canton, and the second on Pine Tree Brook in Milton. Other structural projects have been undertaken which involved replacement of outdated bridges, channel improvement, and the increasing of culvert capacities where necessary. In addition, the main river has been relocated and the channel enlarged as the result of Route 128 highway construction.

Along the headwaters, moderate development does exist and is primarily residential. Industrial development is found along the riverbanks and is primarily responsible for the creation of impoundment areas along the mainstem. The central portion is, for the most part, undeveloped and consists of very extensive marshlands. The lack of development allows this area to act as a large storage area for excessive flows caused by abnormal precipitation. Downstream of the Neponset's intersection with Truman Highway, the area is highly urbanized, the flood plain is encroached upon heavily, and almost all rainfall becomes instantaneous runoff into the river. The Metropolitan District Commission operates a dam at Hyde Park which can be used to help control river flows.

Major wetlands include areas along: the Neponset River and Fowl Meadow, York and Pequid Brooks, Redding Brook, Cedar Swamp, and Mine Brook. Wetlands in Neponset towns of Walpole, Westwood, Stoughton, Sharon, Norwood, Canton, Milton, and Quincy total over 12,000 acres; Canton, Sharon, and Walpole contain nearly 70 percent of the total wetlands in the Neponset watershed.

Despite preventive measures already taken in the basin, future problems may exist if development is allowed to proceed unchecked. Encroachment of the upstream flood plain areas will result in increased river heights in the highly developed areas of Dedham, Hyde Park, Mattapan, and Milton. The *Neponset River Basin Flood Plain and Wetland Encroachment Study* of April 1971, prepared for the Massachusetts Water Resources Commission, provides various flood stage data.

Northern South Shore Towns. Five storms have produced major floods in the Furnace Brook, Town Brook, and Hayward Creek areas of Quincy in the past 20 years. The storm of record in the basin, Hurricane Diane, produced 12.7 inches of rainfall and major flooding during August 1955. A recurrence of this storm would generate an estimated \$1.8 million damages, particularly in the city of Quincy. The March 1968 storm resulted in maximum area flooding and \$1 million damages due to increased urban development, even though there was much less rainfall than in the previous storms. In addition to major flooding from severe storms, minor flooding of streets and cellars follows nearly every heavy rainfall in these watersheds. Flash flood-

ing of Hayward Creek in Quincy has caused damage in General Dynamics' Fore River Shipyard. Under the provisions of Section 205 authority, the Chief of Engineers in January 1975 approved measures along Hayward Creek: diversion of Echo Creek into a temporary storage area above Hayward Pond, minor dike and wall work near the head of Hayward Pond, increasing the storage capacity at Hayward Pond, channel enlargement below the pond, and installation of larger conduits near the shipyard. Construction is scheduled to start in fiscal year 1976, contingent upon funding, with construction requiring about 1.5 years to complete. The Corps is continuing planning study of Furnace Brook and Town Brook.

Hurricane Diane in 1955 caused some damages to commercial/industrial firms in Weymouth and Braintree, particularly to commercial areas in Weymouth Landing when Smelt Brook flooded. In general, flood problems resulted from undersized culverts, narrow or confined stream channels, and construction in Braintree within filled swamp land of relatively low elevation. A \$1.3 million flood control project is being carried out through the Corps of Engineers to construct a dam and make channel improvements which will carry Smelt Brook under Weymouth Landing to Fore River. The target date for completion is early 1976.

Record rainfall during Hurricane Diane in 1955 caused river flooding in East Weymouth in the Weymouth Back River. Drainage during the storm exceeded the capacity of the system of conduits carrying the river from Whitmans Pond to the tidal region, and caused local damage to residential and commercial properties. The Corps points out that the flow capacity of critical points under road crossings will have to be increased to avoid future flooding.

There is also a local flooding problem on the Monaquot River in Braintree. This has been caused by the increasing urbanization which has resulted in increased runoff. The existing channel capacity of the streams is inadequate to carry this increased flow and therefore results in flooding of the downstream areas.

Wetlands

On a statewide scale, Massachusetts is losing its wetlands at a rate of one percent per year. Certain communities near Boston have been estimated as having lost up to 50 percent of their wetlands since 1951. The area between Route 128 and Route 495 is particularly vulnerable to loss of wetlands.

Because of high development pressures in this planning area, municipalities should give special attention to protecting fresh water and coastal wetlands. Specific actions that can be taken are listed in the *Regional Report, Chapter 8*. Special attention should be given to protecting natural storage areas which have water supply value and are also unique natural areas, and/or wildlife habitat areas.

Inland Erosion

The only upland erosion problems in this planning area are those associated with lands undergoing urban development. Erosion on forest land in the area is minimal. In their present condition, soils in this planning area generally have a low erodibility factor, but when protective cover is disturbed or destroyed, these soils will erode at unacceptable rates. Much of the erosion damages can be avoided through a sound urban-environmental forestry program to retain as much of the native vegetation as possible. Without taking the proper erosion control measures in the urbanizing areas, a decrease in environmental quality can be expected. Further, the costs of treating erosion problems, once they have developed, can be high.

Coastal Flooding

The harbor area has an easterly exposure and is subject to attack from the frequent winter northeasters, which can be stalled in the area for several days, and generate prolonged above-normal tidal surges and high waves. In addition, other storms, including hurricanes and extra-tropical storms, have occurred, though usually with lesser impact on tides and waves.

A report prepared by the Corps of Engineers in 1960 presents a general description of the northeast storm of December 29, 1959, and the effects of tidal flooding and wave action on shore structures and protective installations, beaches, private properties, highways, and utilities. Tidal flood damage from this coastal storm was reported to have been serious in the Boston Harbor area. Damages in Boston amounted to about \$1 million, and in Quincy were about \$750,000. Hull suffered damages estimated at \$930,000, Hingham \$5,000, and Weymouth \$70,000.

A hurricane survey report of Massachusetts coastal and tidal areas was published by the Corps of Engineers in 1964. Due to the scattered nature of developments and potential damages, complete hurricane flood protection was found to be impractical and uneconomical. The Division Engineer recommended that no further federal improvements for hurricane protection be undertaken in the Commonwealth at that time. However, the report was published recommending methods of tidal flood protection for local consideration including early warning, zoning, beach raising and widening, concrete walls, bulkheads, and revetments.

Coastal Erosion

Critical coastal erosion occurs at a number of points along the shoreline of the Boston planning area. The Corps of Engineers has identified a number of critical shoreline erosion areas (where erosion is occurring at rates of over about 3 feet per year and protection is needed). Also, some areas of serious bluff erosion have been designated as critical, even though the shoreline may not be receding more than 3

feet per year. Critical erosion areas requiring immediate remedial work include the north shore of Spectacle Island, Great Brewster, and Peddocks Island. Areas needing protection are East Boston, several points along the Boston waterfront, the area along Carson Beach in Boston, northern shore of Gallops Island, Rainsford Island, Peddocks Island, and several points in Quincy. Areas of non-critical erosion, where the erosion is continuing at rates of less than 3 feet per year, may need protection at a future date. These include several points on Thompson Island, the eastern shore of Long Island, and Great Brewster. Continual erosion of most beaches has necessitated artificial nourishment in order to maintain them in their present condition. *Chapter 6 of this report and the Ipswich North Shore report* recommend solutions to similar problems for Nantasket and Revere Beaches. Because of other priorities, the MDC is not interested in beach nourishment measures at these two areas at this time.

The Corps of Engineers has prepared a number of reports on coastal protection projects. Recent protection projects constructed by the Commonwealth with federal cost sharing have included Winthrop Beach, Quincy Shore Beach, and Wessagusset Beach in Weymouth. All three were completed in 1959.

Much work has been done by local and state agencies to preserve and protect the existing beaches and coastal areas. Among several projects presently being undertaken by the Division of Waterways, Massachusetts Department of Public Works, are a number of seawalls in Quincy. In addition, the Boston Redevelopment Authority has been reconstructing a number of deteriorated seawalls in the waterfront area. The Massachusetts Port Authority and the Metropolitan District Commission have responsibility for protection, maintenance, and improvement of coastal facilities and properties in their areas.

The Solutions

Alternatives

As pressure for expansion in the metropolitan area continues, more and more low-lying areas are being developed for commercial and industrial uses as well as housing. This will cause future flood damages to become more severe from storms equivalent to those that presently do not cause severe damage.

Problems in other parts of the Boston planning area may be kept at a minimum if sound flood management principles are implemented and enforced. The most appropriate management program for this planning area consists of three elements: (1) flood plain zoning with the establishment of 50-year encroachment lines; (2) sub-watershed improvements by structural or other means to provide storage volume for

abnormal precipitation; and (3) flood flow regulation utilizing existing structures.

Flood plain zoning will allow the controlled development of areas within the flood plain. Implementation of this measure is especially important in the low lying marshland areas of Canton, Norwood, and Dedham in the Neponset watershed, and along the Aberjona River in the Mystic watershed. Firm encroachment lines should be established based on the limits of a flood which occurs once in 50 years. No construction would be allowed within these encroachment lines, and sufficient storage area will be retained to handle the 50-year event. Structures already existing within these encroachment lines would be allowed to remain, but no additions may be made to them.

Sub-watershed improvements should be initiated where it has been shown that significant damage has or will occur due to future development in the planning area. An evaluation of the causative factors should be made to determine if flooding problems result primarily from inadequate local drainage conditions. If it is found that local drainage conditions and structures are poor, it may be most feasible to replace them with properly sized facilities. If, however, flooding problems appear to be occurring due to increased runoff, a sub-watershed storage area may be in order. The main impact of these storage areas is that they allow the release of large volumes of stored floodwaters at a controlled rate. This can have a significant effect in reducing flood stages along the mainstem as well as along the tributary it protects. In addition to reducing flood damages, sub-watershed improvements can be utilized as recreational areas and wildlife habitats.

At the present time, sub-watershed improvement appears to be immediately feasible in the Diamond Brook watershed in Walpole, the lower portion of Horn Pond Brook in Winchester, the lower portion of Mill Brook in Arlington, the upper portion of Alewife Brook in Arlington, and the upper portion of the Malden River where it passes through Malden Square. Further detailed studies are required to determine the most economically feasible solutions to these problem areas. The Soil Conservation Service is presently conducting a PL-566 small watershed protection study of the Diamond-Traphole Brooks area.

Flood flow regulation, using existing structures, can be used to reduce flood stages at various points along the river. For example, in the Neponset basin, the dams, if properly operated, can serve an important role in protecting the upstream areas of Foxboro, Walpole, and Norwood. Downstream facilities for flood flow regulation exist at the Metropolitan District Commission dam in Hyde Park, which can help provide protection to the vulnerable areas of Mattapan Square and Milton Lower Mills. One of the most important considerations is that no new structures are required.

In coastal areas, alternatives considered were: (1) restore and protect critical shoreline areas with physical structures to meet present needs for restoration and protection of eroded land and provide a reasonable degree of future protection. The beach restoration could probably be done on a regional basis; the other eroded areas would have to be done on an individual and private basis; (2) establish a rigid coastal zone management program precluding further encroachment of inappropriate development, and providing guidelines for future planning and proper development.

Recommendations

A major result of the SENE Study has been the classification of the region's resources according to their capability for development. In the Boston Metropolitan planning area, inland wetlands (about 47,000 acres) and coastal wetlands (about 1,400 acres), estuaries, beaches, barrier beaches, and critical coastal erosion areas have been classified as "A" resources or "priority protection areas" requiring the greatest degree of protection from development. Flood plains (some 39,400 acres) and hazardous coastal flooding areas (about 8,000 acres) (both to the 100-year frequency line) have been classified as "B" resources or "other protection areas" which have very limited tolerance for development, but with proper management are suitable for such compatible activities as agriculture or recreation. All of these resources have been classified as Critical Environmental Areas.

In keeping with this resource classification, it has been recommended that comprehensive flood plain management programs be developed for flood prone areas, making use of non-structural solutions wherever possible. All such programs should be developed in close cooperation between federal and state agencies, regional planning agencies, and local governments and interests. They should also be coordinated with related programs, such as the National Flood Insurance Program, the National Weather Service, state wetlands acts, state land use planning programs, and for coastal areas, with state coastal zone management programs.

Section 73 of the Water Resources Development Act of 1974 authorizes federal cost sharing for non-structural measures. Although implementation of Section 73 has presently been deferred by the Office of Management and Budget (OMB), application of the cost sharing authority can be an important factor in making non-structural solutions more competitive than they have been.

An area particularly appropriate for development of a comprehensive flood plain management program is the Neponset River watershed. Consideration should also be given to developing a similar program for the Mystic River watershed.

The Study therefore recommends that the appropriate authorities:

1. Develop a flood plain management program for the Neponset Watershed.

The Corps of Engineers, in close cooperation with state, regional, and local officials, should develop a comprehensive flood plain management plan for the Neponset watershed.

In this plan, particular emphasis should be given to non-structural methods of flood protection, including flood plain zoning, wetlands protection, flood proofing, expanded storm and flood forecasting and warning services, and removal of flood prone structures. Such plans should be coordinated with land use planning programs as they are developing, and, for coastal areas, with the state coastal zone management program. The study should also be coordinated with ongoing work by the Soil Conservation Service in the Diamond-Traphole Brooks area.

2. Apply structural solutions selectively.

The agencies developing the comprehensive flood plain management plan should consider a combination of debris removal, dam removal or regulation, and bridge opening adjustments, together with strong non-structural measures as alternatives to major structural measures.

Despite the existence of extensive natural valley storage areas, significant development in the flood plain has precluded fully adequate protection from flood damages through wetlands protection. Construction of the Charles River Dam and improvements to the Amelia Earhart Dam are underway.

Maintenance of existing structures is also a part of an overall flood plain management program. Growing interest in and support of rehabilitating mill dams is being expressed by municipal officials and citizen groups (see *Chapter 6*). Dam maintenance together with coordinated operation could help to keep the limited flood retention capacity of mill ponds intact, as well as offer recreation opportunities, and, in some cases, small scale power.

For a town adjoining the Neponset watershed, authorities should:

3. Study flooding problems in Braintree.

Local interests should request the Corps of Engineers to investigate the flooding problems on the Monaquot River in Braintree under the authority of the Section 205 Program.

Throughout the planning area, municipalities should:

4. Adopt flood plain zoning preventing adverse flood plain development in flood prone areas (and particularly the 100-year floodway) as defined under the National Flood Insurance Program.

This also includes incorporating inland and coastal wetlands, eroding areas, and storms of record on the map upon which the zoning is based. All related regulations — building codes, subdivision regulations, sanitary codes — should reinforce this policy of preventing adverse development and redevelopment in the 100-year flood plain. The regulations should also take advantage of the restrictive provisions of state wetlands regulations, scenic rivers programs, and the like.

Related to local zoning action are two recommendations for controlling local sedimentation and inland erosion problems. Municipalities, assisted by the U. S. Department of Agriculture and the Executive Office of Environmental Affairs should:

5. Establish local sediment and erosion control ordinances.

A model for such ordinances is included in the more detailed information prepared for the Study and available in the NERBC files. To protect streambanks and water bodies, the Critical Environmental Areas (*Chapter 3*), the Study recommends municipalities:

6. Establish forest buffer zones. Municipalities should establish appropriate forest buffer zones within 200 feet of streams and lakes to preserve vegetation and maintain natural systems through forestry techniques to help keep non-point source pollutants from reaching sensitive water quality areas.

Towns with existing high and medium high development pressure (see *Chapter 3, Guiding Growth*) should be among the first to implement these two recommendations.

To reinforce these zoning ordinances, municipalities should:

7. Establish local regulations. Municipalities should ensure that all local regulations, including building and sanitary codes, reinforce the intent of the zoning ordinances recommended above.

In conjunction with a zoning program, efforts should be strengthened to:

8. Acquire significant wetlands and flood plains. Municipalities and state agencies should investigate continuing possibilities to acquire those wetlands and flood plain areas

most significant for flood damage reduction and protection, and those which have water-supply value and wildlife and/or recreation values.

Particular emphasis should be given to protection of areas classified as unique natural areas and those located in areas subject to high and medium development pressure as outlined above.

Protection of wetlands and flood plains is also expected to help existing structural flood protection projects do their job by keeping flood flows to within the design capacity of the existing dams, channels, etc. In built-up and heavily used areas alternative locations outside the flood plain may not always be feasible. One way to cope with this situation is to:

9. Locate in existing safe buildings in the flood plain. Where location outside the flood plain is not feasible, municipalities should encourage private interests to locate in existing safe buildings in the flood plain rather than permitting new construction in the flood plain.

Floodproofing, especially of existing buildings, is particularly appropriate where only moderate flooding is expected, where other types of flood protection are not feasible, or where activities requiring a waterfront location need some degree of protection. Improved and expanded storm and flood forecasting and warning services, recommended in *Chapter 8 of the Regional Report*, will also be important in keeping down future damage costs.

The *Regional Report, Chapter 8*, contained recommendation for specifically including critical coastal erosion areas within the 100-year coastal flood prone areas, all of which would be protected as part of the state coastal zone management program.

On a local level, recommendation number 4 called for prohibiting development and other damaging uses of critical erosion areas through local flood plain zoning. In addition, municipalities should:

10. Encourage natural stabilization of coastal areas. Municipalities and conservation commissions should continue to encourage natural means of stabilizing coastal erosion areas, giving priority to areas experiencing critical rates of coastal erosion (3 feet or more per year).

Use of vegetative cover, snow fences, discarded Christmas trees, and boardwalks have proven effective approaches to control accelerating rates of wind and wave erosion.

No specific sites have been identified for structural erosion control projects in this planning area. However, *Chapter 8 of the Regional Report* recommends selective construction of erosion control projects for areas other than beaches, such as eroding bluffs (except for unique natural sites). Artificial beach nourishment does not provide substantial benefits unless public recreational benefits are added in as well. Therefore, further discussion of the possibilities for beach nourishment are included in the *Outdoor Recreation chapter of this report*. Any studies and projects should address the littoral drift relationships between beach erosion and headland protection.

Implications

This approach is a good deal more restrictive than the

National Flood Insurance Program requires. But it does make full recognition of resource limitations and natural functions of wetland and flood plain areas. The SENE Study has found that all new development can be accommodated in C, F, and G lands (*as discussed in the Guiding Growth chapter*), so that protecting A and B lands from inappropriate use need not be incompatible with a growing economy. In fact, a policy of resource protection and non-structural solution is regarded as a significant step toward protecting the physical beauty of the region's landscape which is expected to be in the long-term interest of the SENE region. Finally, protecting A and B lands reserves productive wildlife habitats and natural areas for recreational purposes.

CHAPTER 9 LOCATING KEY FACILITIES

As with other planning areas in the SENE Study region, the Boston Metropolitan area has its share of key facilities — sand and gravel pits, stone quarries, and power plants. However, the heavily urbanized nature of much of the area has the effect of placing pressure for future siting of these services in the last remaining open spaces. Both the services and the open spaces are vitally needed, and classic conflicts arise.

SAND AND GRAVEL MINING

Processed sand and gravel is produced at 11 plants in the planning area: two each at Holliston and Walpole, and one each in Bellingham, Millis, Norfolk, Wrentham, Weymouth, Canton, and Stoughton. In the Charles basin portion of the planning area alone, nearly 1.2 million tons of sand and gravel valued at almost \$1.7 million was produced. Crushed stone, quarried in Weston, West Roxbury, Wrentham, and Weymouth totalled over 900,000 tons and was valued at nearly \$2 million. Finally, some dimension stone was quarried at two sites in Milford (granite) and one each in Walpole (sandstone), Weymouth, and Hingham. Crushed stone produced just outside the planning area in Revere is consumed in the Boston area.

With remaining potential sites rapidly being preempted by other forms of development, the construction aggregate business is slipping in this area. The inevitable result is importation of materials from elsewhere in the state, at substantially increased cost. It is a common irony that where construction and the resultant need for aggregate is greatest, availability of materials is the lowest. At least one company in Boston is importing trainloads of aggregate from New Hampshire.

With the feasibility of mining sand and gravel from the Bay in question, only two alternatives appear to remain: increase costly imports, or identify and preserve remaining deposits. In fact, in this planning area, a combination of the two appears to be the most likely course. However, locating mining operations in Boston's suburbs will not be willingly accepted by residents.

The antipathy of many communities to sand and gravel operations is understandable; they are noisy, dirty, and they have a decidedly negative effect on surrounding property values. The stiff regulations adopted by most communities to prohibit extraction operations, and the subsequent preemptive development which occurs, serve to all but eliminate the use of in-basin resources.

The recommendations made in *Chapter 9 of the Regional Report* are expected to be sufficient to preserve and regulate

extraction in the planning area. The recommendations provide for the Massachusetts Department of Environmental Quality Engineering to set statewide operating standards with local land use approvals, provide a permitting procedure for all extraction operations, and oversee site reclamation. Perhaps more importantly, the recommendations provide for a statewide survey of potential sand and gravel sites to provide a basis for protection of the resource for future use. Through a carefully planned program of sequential use of mineral deposit sites, adequate sand and gravel can be provided at the least environmental and economic cost to residents of the planning area.

POWER GENERATION FOR METROPOLITAN BOSTON

Boston's options for power plant siting are limited. With demand for electricity steadily increasing, though according to Boston Edison at slightly lower rates, the metropolitan area offers few options for siting major new power plants.

Utility service in the area is provided by Boston Edison Company, New England Electric System, Cambridge Electric Light Company, and the municipalities of Belmont, Braintree, Wellesley, and Norwood. Boston Edison and the New England Electric System supply over 90 percent of the total requirements of this area. In 1971, five fossil fuel plants with an installed capacity of 1582.6 megawatts operated in the Mystic and Charles basins. During 1971 these five plants generated a total of 7.7 billion kilowatt hours, or 29.2 percent of the total SENE service area's generation. There are four gas turbine plants operating in the Mystic and Charles River basins. The largest, 135.2 megawatt, is at West Medway and is operated by Boston Edison Company.

Scheduled for completion in 1975 at the Mystic Station is Unit #7, which will have a 587 megawatt fossil steam capacity. In addition, construction was completed in 1972 on a 24 megawatt gas turbine peaking unit at the Kendall Gas Turbine plant located in Cambridge.

PETROLEUM DISTRIBUTION AND STORAGE

While the SENE region's petroleum system is discussed in greater detail in *Chapter 9 of the Regional Report*, the Boston Metropolitan planning area warrants special attention. The Massachusetts Port Authority (Massport) recently released an interim report identifying, in order of preference,

sites off Newburyport and Nahant as potential deepwater oil terminals.

The Study is in substantial agreement with the fundamental concept behind the Massport investigations: that a deep-water oil terminal is more economical and preferable to increases in risky coastal tanker traffic in the region's harbors. At the same time, more information on the opportunity costs to the environment and economy are needed.

Moreover, since the feasibility of the terminal is dependent on the construction of a refinery for processing the delivered crude, and the New England Regional Commission is investigating the regional implications of refinery and

other petroleum facilities siting, the SENE Study concludes that the facilities siting question should be decided within the New England regional context.

Consequently, the Study recommends:

- 1. Study deepwater port facility off Metropolitan Boston within a New England-wide context. If the Massport study is reactivated, it should be conducted in cooperation with the Massachusetts Coastal Zone Program and Energy Facilities Siting Council (appropriately authorized) and the siting and coastal zone programs of the other four New England states.**

NOTES

1. *Phragmites australis* (Cav.) Trin. ex Steud.

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1. Administrative
 2. Financial
 3. Personnel
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 5. Marketing
 6. Research & Development
 7. Legal
 8. Public Relations
 9. Information Systems
 10. Facilities
 11. Transportation
 12. Utilities
 13. Insurance
 14. Investment
 15. Other

Water Resources Commission: Robert E. Lane
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formerly Department of Natural Resources)
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Division of Water Pollution Control; Tom Mac-
parment of Public Health; George Logan
Division of Environmental Health (formerly De-
partment of Environmental Quality Engineer-
ing
Department of Environmental Quality Engineer-
ing
Resource Management Policy Council
May 1975; David Perry
Lewis S. B. Thompson, Commissioner, in Feb-

[illegible]

Statement of the Board of Directors

Nichols was of Soviet origin.

U.S. Geological Survey, Federal Highway

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